BELIMO

Wiring for Damper Actuators and Control Valves

July 2011



Wiring for Damper Actuators and Control Valves

General Wiring Instructions

WARNING: The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer's installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformer(s)
Belimo actuators require a 24 VAC Class 2 transformer. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

– EMC Directive: 2004/108/EC
– Software Class A: Mode of Operation Type 1
– Low Voltage Directive: 2006/95/EC

Example: 3 AF Actuators Supplied, 16 Ga. wire (refer to table on page 3)
350 ft. (allowable wire length) ÷ 3 actuators = 117 ft. maximum wire run

Typical Transformer Sizing

Actuator Series	Voltage	Required VA Per Actuator
EFB, EFX	24	16
AFB, AFX	24	10
AF	24	10
NFB, NFX	24	9
LF	24	7
TF	24	5
GMB	24	7
AMB / ARB	24	6
NMB	24	6
LMB / LRB	24	3
CMB	24	1.5
AHB	24	4.5
LHB	24	3
LUB	24	3
AMQB	24	26
NMQB	24	23
LMQB	24	23
AHQB	24	23
LHQB	24	23
GK / GKR	24	21
NK	24	22
AHK	24	20

CAUTION: It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple actuators, one transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:

1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hotleg. Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple actuators, multiple transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire type and wire installation tips

For most installations, 18 or 16 Ga. cable works well with Belimo actuators. Review job requirements and determine whether a plenum or appliance rated cable is appropriate. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unspliced from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

Wire length for actuator installation

Keep power wire runs below the lengths listed in the following tables. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

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Wire Size vs. Length of Run for Damper Actuators and Control Valves

24 VAC

VA / wire gauge	EF	AF	NF	LF…US	TF…US	GK/ GKR…	NKQ…	GM/GR…	AM/AR…	NM…	LM/LR…	CM…	AH…	LH…	LU…	TR…	AMQ… NMQ… LMQ… AHQ… LHQ…
	16	10	9	7	5	21	22	7	6	6	5	1.5	6	5	5	1	18
	MAX Distance between Actuator and Supply (feet)																
20								175	200	200	250	800	200	250	250	1100	70
18	145	220	250	325	450	110	105	325	375	375	450	1150	375	450	450	1200	125
16	225	350	390	500	700	165	160	500	600	600	700	1200	600	700	700	1400	200
14	360	550	600	800	1100	275	260	800	925	925							300
12	550	900	1000	1125	1175	440	420	1125	1150	1150							500

110 VAC

VA / wire gauge	EF	AF..UP	AF	NF..UP	LF…US	TF…US	GM…	AM…	NM…	LM…	CM…	LU
	21	8.5	11	6.5	7.5	6	7	7.5	6.5	4.5	3.5	3
	MAX Distance between Actuator and Supply (feet)											
20							175	150	175	250	350	400
18	110	265	215	375	325	375	325	300	325	450	600	750
16	165	415	345	575	500	575	500	450	500	700	1000	1125
14	275	650	545	900	800	900	800	700	800	1125	1150	1175
12	440	1050	895	1150	1125	1150	1125	1125	1125			

220 VAC

VA / wire gauge	EF	AF..UP	AF…US	NF..UP	LF…US	TF…US	GM…	AM…	NM…	LM…	CM…	LU
	29	18	11	9.5	7	6	7	7.5	6.5	4.5	3.5	3
	MAX Distance between Actuator and Supply (feet)											
20							175	150	175	250	325	400
18	80	120	215	220	325	375	325	300	325	450	600	750
16	125	200	345	350	500	575	500	450	500	700	1000	1125
14	200	300	545	550	800	900	800	700	800	1125	1500	1175
12	310	475	895	900	1125	1150	1125	1125	1125			

***Belimo actuators and auxiliary switches are designed as a IEC protection class II, double insulated, and do not require an independent ground wire to earth, unless otherwise indicated in this document**

Wire Size vs. Length of Run for SY Series Actuators

		SY1	SY2	SY3	SY4	SY5
		Amps	Amps	Amps	Amps	Amps
24 VAC	wire gauge	1.8	3	3	6	6.5
		MAX Distance between Actuator and Supply (feet)				
	18	92	55	55		
	16	144	87	87	43	40
	14	233	140	140	70	65
	12	357	214	214	107	99
	10	606	364	364	182	168
	8	905	543	543	271	250

		SY1	SY2	SY3	SY4	SY5	SY6	SY7	SY8	SY9	SY10	SY11	SY12
		Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps
110 VAC	wire gauge	0.5	1	1	1.3	1.5	1.8	3.2	4	3.2	4	3	4
		MAX Distance between Actuator and Supply (feet)											
	18	1515	758	758	583	505	421	237	189	237	189	253	189
	16	2381	1190	1190	916	794	661	372	298	372	298	397	298
	14	3846	1923	1923	1479	1282	1068	601	481	601	481	641	481
	12	5882	2941	2941	2262	1961	1634	919	735	919	735	980	735
	10	10000	5000	5000	3846	3333	2778	1563	1250	1563	1250	1667	1250
	8	14925	7463	7463	5741	4975	4146	2332	1866	2332	1866	2488	1866

		SY1	SY2	SY3	SY4	SY5	SY6	SY7	SY8	SY9	SY10	SY11	SY12
		Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps
220 VAC	wire gauge	0.3	0.5	0.5	0.6	0.7	0.8	1.6	2	1.6	2	1.6	2.2
		MAX Distance between Actuator and Supply (feet)											
	18	5051	3030	3030	2525	2165	1894	947	758	947	758	947	689
	16	7937	4762	4762	3968	3401	2976	1488	1190	1488	1190	1488	1082
	14	12821	7692	7692	6410	5495	4808	2404	1923	2404	1923	2404	1748
	12	19608	11765	11765	9804	8403	7353	3676	2941	3676	2941	3676	2674
	10	33333	20000	20000	16667	14286	12500	6250	5000	6250	5000	6250	4545
	8	49751	29851	29851	24876	21322	18657	9328	7463	9328	7463	9328	6784

The NEC mandates that 24 VAC over 100 VA power requires CLASS 1 wiring conduit. Local codes may vary. Do NOT mix CLASS 1 & CLASS 2 circuits in the same conduit. Generally, 24 VAC actuators over 100 VA should be changed to 120 VAC models.

W236_11

Actuators: EFB24(-S) EFX24(-S) AF24(-S) US NFB24(-S) NFX24(-S) LF24(-S) US
TF24(-S) US GKB24-3 GKX24-3 NKQB24-1 NKQX24-1

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

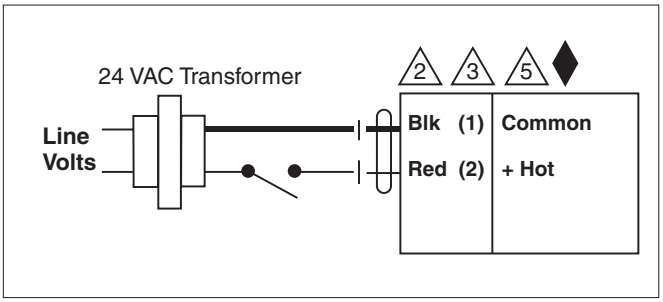
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

On/Off



INSTALLATION NOTES

△1 Provide overload protection and disconnect as required.

△3 Actuators may also be powered by 24 VDC.

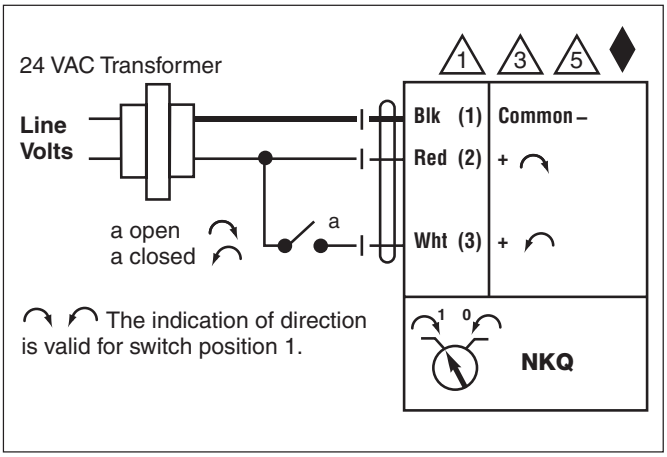
△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead.

Ⓐ Actuators with appliance cables are numbered.

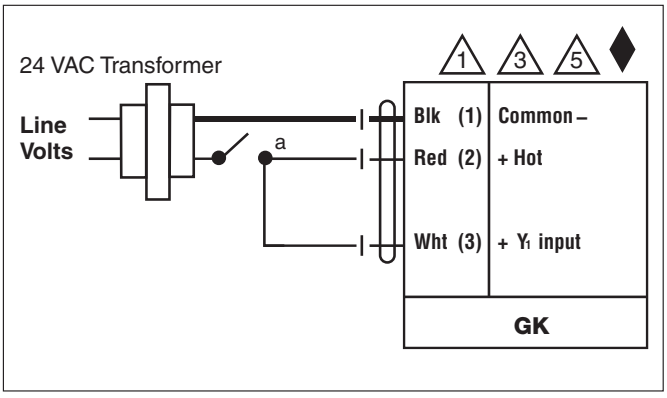
APPLICATION NOTES

♦ Meets cULus requirements without the need of an electrical ground connection.

On/Off



On/Off



Refer to page 26 for auxiliary switch (-S models) wiring.

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W231_A_11

Actuators: EFB120(-S) EFX120(-S) AFBUP(-S) AFXUP(-S) AF120(-S) US/AF230(-S) US NFBUP(-S) NFXUP(-S) LF120(-S) US/LF230(-S) US TF120(-S) US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING

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INSTALLATION NOTES

△14 TF120(-S) US can be supplied with both 120 VAC and 230 VAC.

△19 UP models and TF120(-S) US uses “L” instead of “H” on #2 wire.

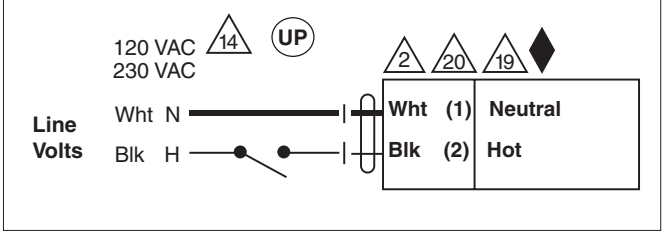
△20 All 120 VAC, 230 VAC and UP actuators use appliance rated cables.

(UP) Universal Power Supply (UP) models can be supplied with 24 VAC up to 240 VAC.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

On/Off



Refer to page 26 for auxiliary switch (-S models) wiring.

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W232_11

Actuators: LF24-3(-S) US TF24-3(-S) US LFC24-3...US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING

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INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC.

△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

△6 Actuators Hot wire must be connected to the control board common.

△11 For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller. The actuator must be connected to the control board common.

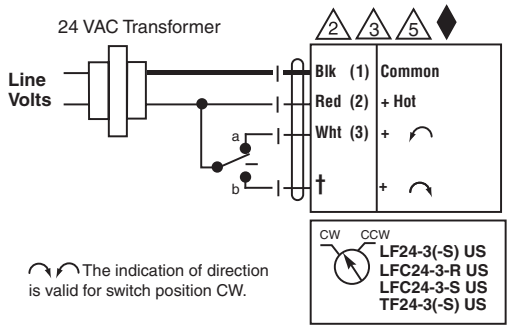
APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

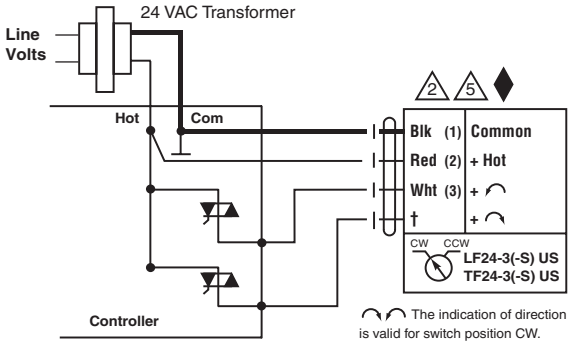
†

Actuator	Wire Number	Color
TF24-3 US	4	Org
TF24-3-S US	5	Org
LF24-3 US	4	Grn
LF24-3-S US	5	Wht

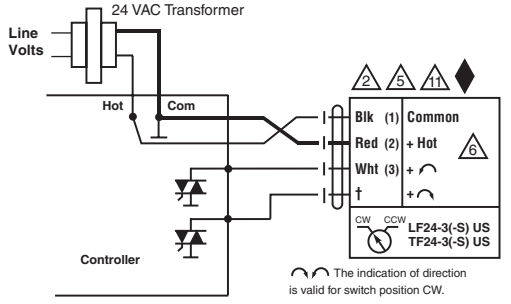
Floating Point



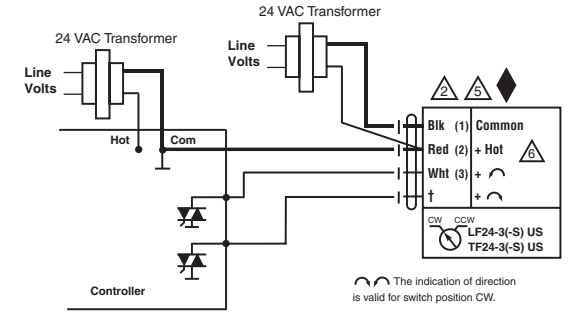
Triac Source



Triac Sink



Triac Sink with Separate Transformer



Refer to page 26 for auxiliary switch (-S models) wiring.

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Wiring for Damper Actuators and Control Valves

On/Off and Floating Point, Non-Spring Return, 24V

W332_11

Actuators: LMB24-3(-S) (-P5) (-P10) (-T) TR24-3(-T) US CMB24-3… NMB24-3 ARB24-3-5 AMB24-3(-S) GMB24-3… GRB24-3-5 LMX24-3(-T) NMX24-3(-T) GRB24-3-7 AMX24-3(-T) GMX24-3… GMB24-3-X1 LRB24-3(-S) ARB24-3(-S) LRCB24-3(-S) ARX24-3 LRX24-3

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING

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INSTALLATION NOTES

3 Actuators may also be powered by 24 VDC.

5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

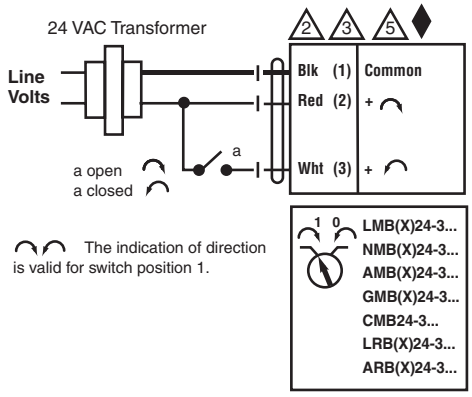
16 The TR24-3-T US actuators are provided with a numbered screw terminal strip instead of cable.

17 TR24-3 US actuators cannot be wired in parallel.

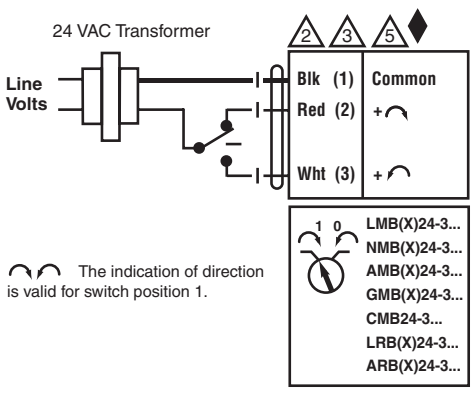
APPLICATION NOTES

♦ Meets cULus requirements without the need of an electrical ground connection.

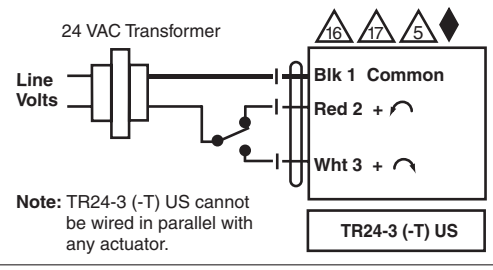
On/Off



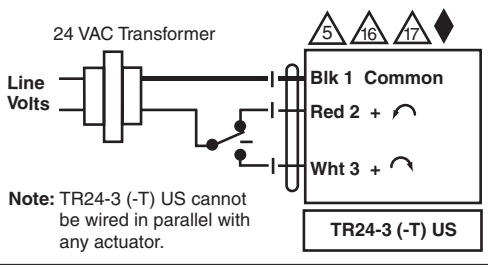
Floating Point



On/Off – SPDT Switch



Floating Point



Refer to page 26 for auxiliary switch (-S models) and -P5, -P10 potentiometer wiring.

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W612_11

Actuators: GKB24-3

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

INSTALLATION NOTES

△1 Provide overload protection and disconnect as required.

△3 Actuators may also be powered by 24 VDC.

△5 Control signal may be pulsed from either the Hot (source) or the Common (sink) 24 VAC line.

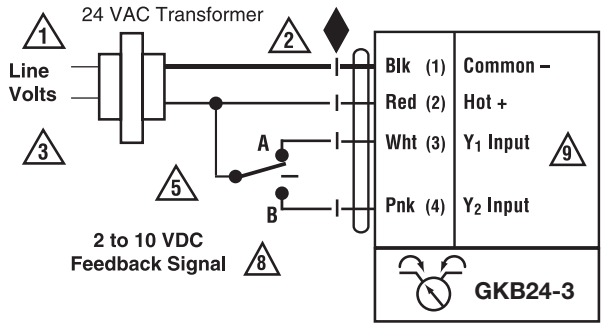
△8 Contact closures A & B also can be triacs.
A & B should both be closed for triac source and open for triac sink.

△9 For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

Floating Point



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Wiring for Damper Actuators and Control Valves

On/Off and Floating Point, Non-Spring Return, 100 to 240V

W364_11

Actuators: LMX120-3, NMX120-3, AMX120-3, GMX120-3, LRX120-3, ARX120-3, CMB120-3

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

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△2 Equipment damage!
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WARNING

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INSTALLATION NOTES

△15 LMB(X), NMB(X), AMB(X), GMB(X), LRB(X), and ARB(X) can be supplied with either 120 VAC or 230 VAC.

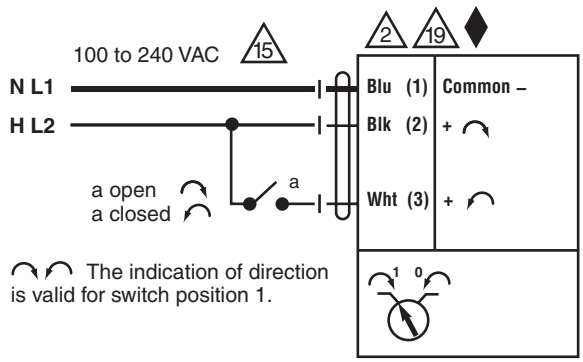
△19 All 120VAC and 230VAC actuators use appliance rated cables.

Ⓐ Actuators with appliance cables are numbered.

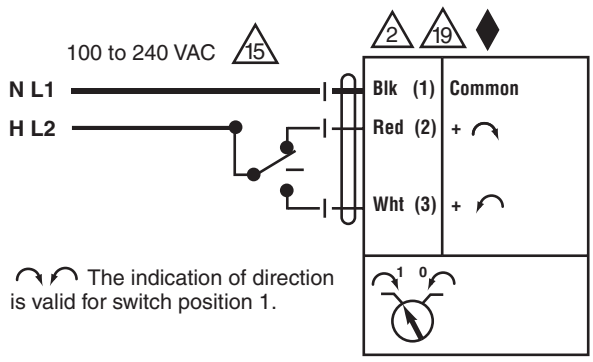
APPLICATION NOTES

♦ Meets cULus requirements without the need of an electrical ground connection.

On/Off



Floating Point



Refer to page 26 for auxiliary switch (-S models) wiring.

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W233_A_11

Actuators: EFB24-SR(-S) EFX24-SR(-S) AFB24-SR(-S) AFX24-SR(-S) AF24-SR US AFA24-SR US NFB24-SR(-S) NFX24-SR(-S) LF24-SR(-S) US TF24-SR(-S) US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△4 Equipment damage!
Up to four actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC.

△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

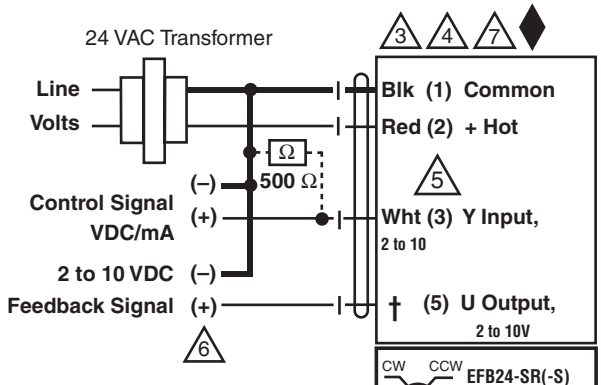
△6 Only connect common to neg. (–) leg of control circuits.

APPLICATION NOTES

♦ Meets cULus requirements without the need of an electrical ground connection.

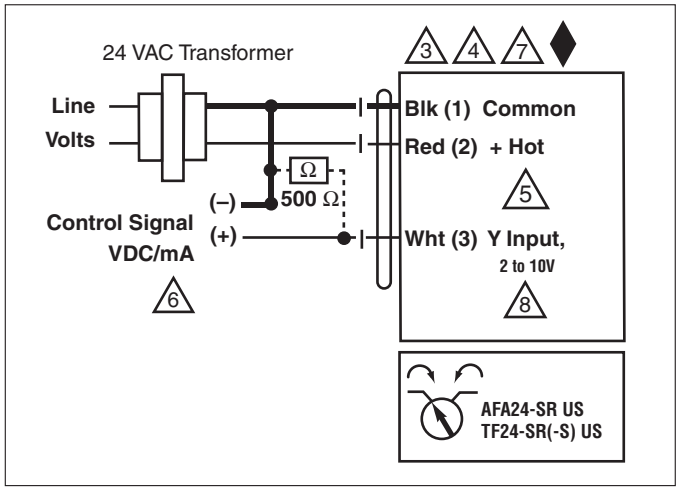
△7 A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

△8 The AFA24-SR US and TF24-SR(-S) US are supplied without position feedback.



†

Actuator	Wire Number	Color
EFB24-SR(-S)	5	Org
EFX24-SR(-S)	5	Org
AFB24-SR(-S)	5	Org
AFX24-SR(-S)	5	Org
AF24-SR US	5	Wht
NFB24-SR(-S)	5	Org
NFX24-SR(-S)	5	Org
LF24-SR US	5	Grn
LF24-SR-S US	5	Wht



Refer to page 26 for auxiliary switch (-S models) wiring.

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Wiring for Damper Actuators and Control Valves

Proportional, Non-Spring Return, Electronic Fail-Safe, 24V

W333_11

Actuators: LMB24-SR (-T) NMB24-SR LMX24-SR (-T) NMX24-SR (-T) LRB24-SR TR24-SR (-T) US
AMB24-SR GMB24-SR AMX24-SR (-T) GMX24-SR ARB24-SR LRX24-SR ARX24-SR
CMB24-SR-L CMB24-SR-R GKB24-SR GKX24-SR NKQB24-SR NKQX24-SR

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△4 Equipment damage!
Up to four actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC.

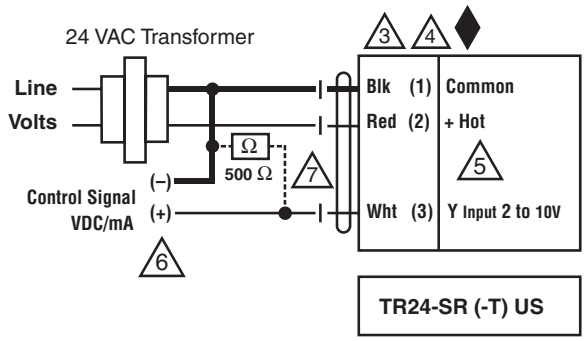
△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

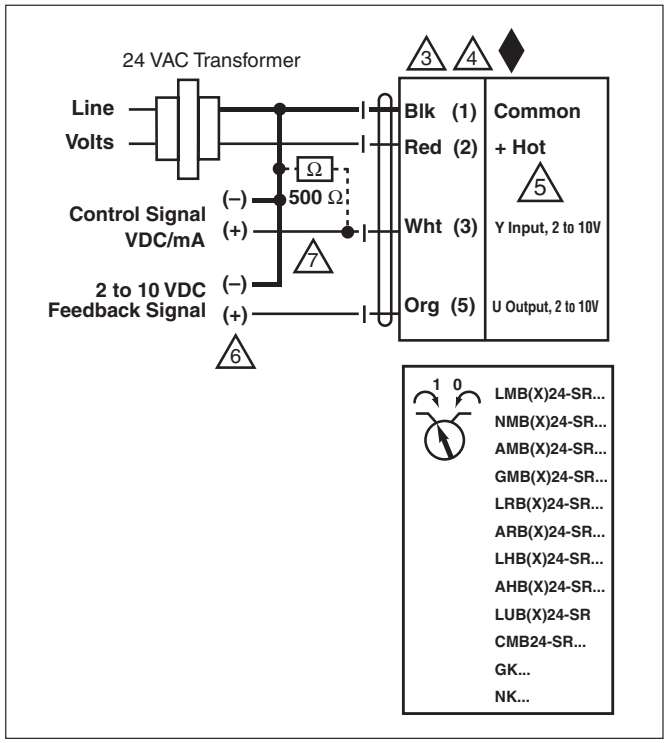
△6 Only connect common to neg. (–) leg of control circuits. Terminal models (-T) have no-feedback.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

△7 A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.





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W365_11

Actuators: LMX120-SR AMX120-SR ARX120-SR
NMX120-SR LRX120-SR

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

INSTALLATION NOTES

△15 LMB(X), NMB(X), AMB(X), GMB(X), LRB(X), and ARB(X) can be supplied with either 120 VAC or 230 VAC.

△6 Only connect common to neg. (–) leg of control circuits.

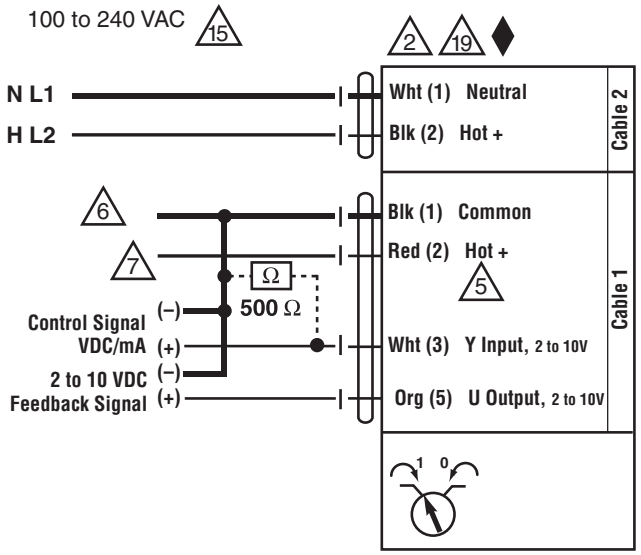
△19 All 120 VAC and 230 VAC actuators use appliance rated cables.

Ⓐ Actuators with appliance cables are numbered.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

△7 A 500 Ω resistor converts the 4 to 10 mA control signal to 2 to 10 VDC.



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Wiring for Damper Actuators and Control Valves

Phasecut Control Signal, Spring Return and Non-Spring Return, 24V

W225_2_11

Actuators: AF24-PC US, NMX24-PC, LMX24-PC, GMX24-PC, AMX24-PC, ARX24-PC, LRX24-PC

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

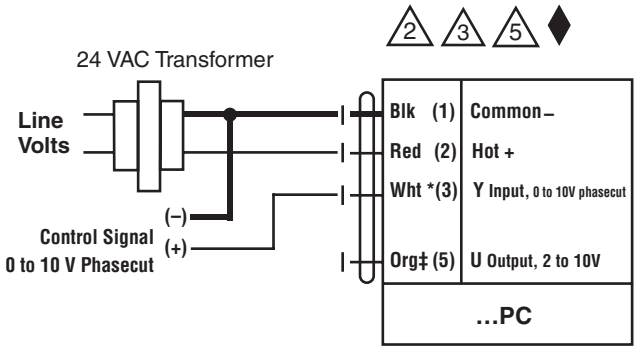
CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



* White color wire for AF24-PC US, Pink color for all others.
‡ White color wire for AF24-PC US, Orange color for all others.

INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC.

△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

APPLICATION NOTES

♦ Meets cULus requirements without the need of an electrical ground connection.

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W604_11

Actuators: LF24-ECON-R03 US LF24-ECON-R10 US AF24-ECON-R03 US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

INSTALLATION NOTES

△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

△26 Min-position is adjustable from 0 to 100% with a potentiometer on the actuator cover.

△27 A relay or switch can spring return the actuator when the RTU fan de-energizes, or if low ambient temperature is sensed.

△28 A standard relay can be used to close the sensor circuit to engage economizer mode, e.g. outside air changeover device like a dry bulb or enthalpy limit switch. Honeywell® logic module W7459A and enthalpy sensor C7400 also provide terminals for this switching.

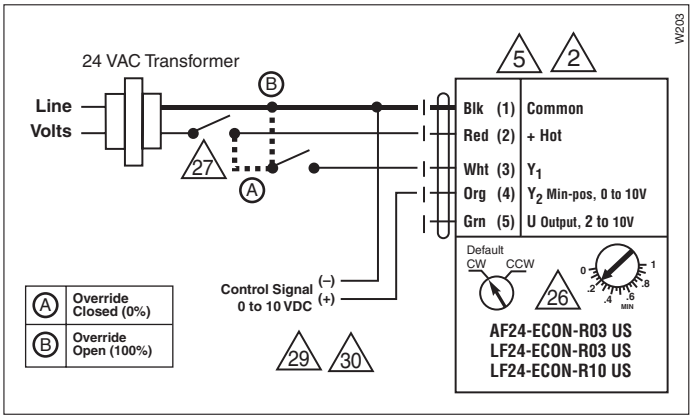
△29 A remote CO2 sensor or DDC controller can change the standard relay opening or closing the sensor circuit. This device can be a relay or a dry bulb/enthalpy limit switch.

△30 Override control for Y2 only accepts 0 to 10 VDC override control.

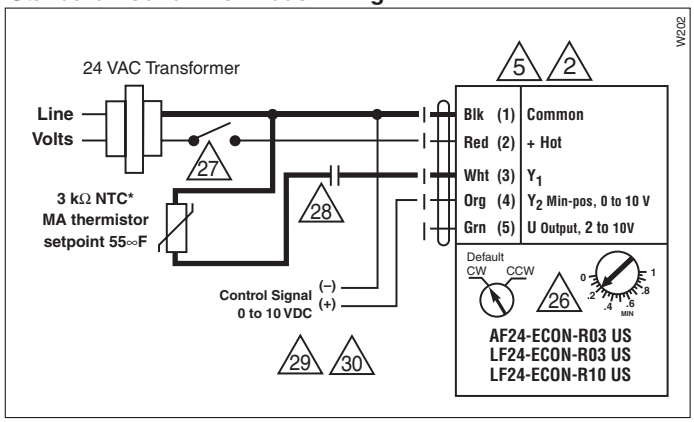
Override Control

Wire	Input Signal	AF24-ECON LF24-ECON… position	Application
Y1	24 VAC	Drive closed (0%)	Morning warm-up cycle
Y1	Common	Drive open (100%)	Smoke Purge
Y1	Open wire	Drive to min. position	Mechanical cooling in use, RTU thermostat calls for heat.
Y2	0 VDC to 10 VDC	Min. position of 0% to 100%	Override potentiometer via a remote C02 sensor/controller or DDC controller.

Override



Standard Economizer Mode Wiring



*10 kΩ NTC thermistor for -R10 types.

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Wiring for Damper Actuators and Control Valves

Proportional, Spring Return, 24V, 2 to 10 VDC (or 4 to 20 mA)
Control Signal or Three-Position On/Off Control

W605_11

Actuators: LF24-SR-E US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

APPLICATION NOTES

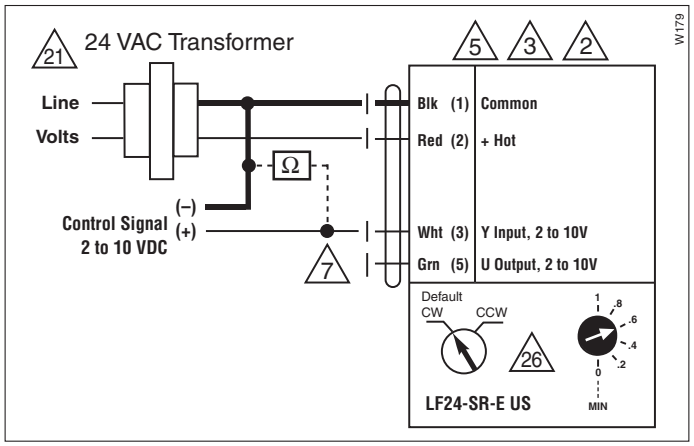
- Meets cULus requirements without the need of an electrical ground connection.

21 Provide overload protection and disconnect as required.

Three-Position Control Signals			
Switch A	**Wire 2-Red (x)**	**Wire 3-White (D)**	**Position**
Open**	Any	Any	Closed (via spring)
Closed	24 VAC	Open	Min-position*
Closed	Open	24 VAC	Full Open*
Closed	24 VAC	24 VAC	Full Open*

* Desired position achieved by driving actuator with motor.
** An example would be to interlock the actuator power supply with the fan motor starter.

2 to 10 VDC Control of LF24-SR-E US



INSTALLATION NOTES

3 Actuators may also be powered by 24 VDC.

5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

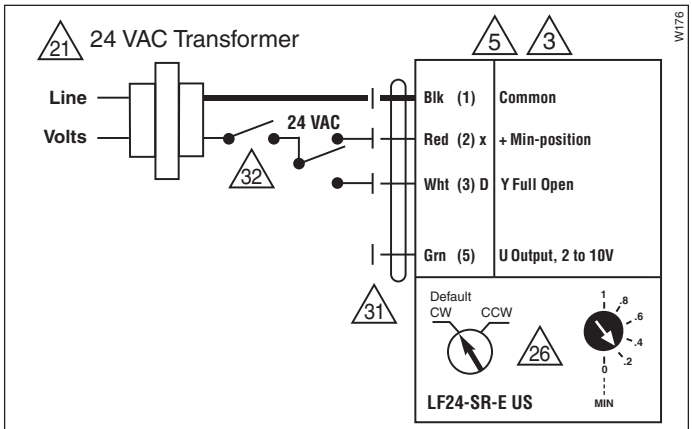
7 A 500 Ω resister converts the 4 to 20 mA control signal to 2 to 10 VDC.

26 Min-position is adjustable from 0 to 100% with a potentiometer on the actuator cover.

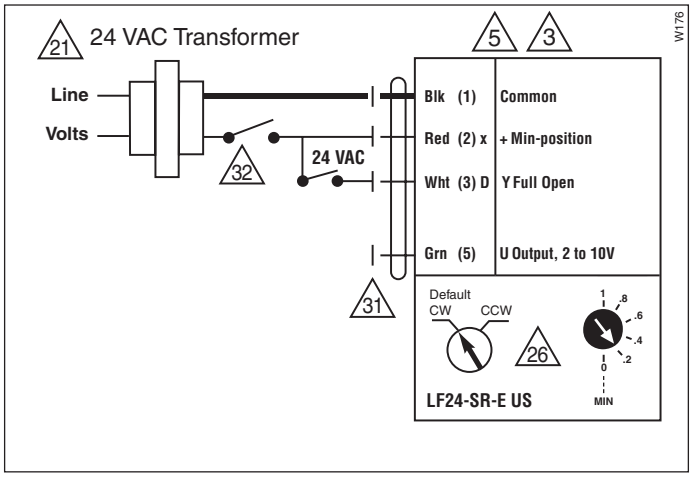
31 For three-position control set direction of rotation to CW (default).

32 Switch A, actuator spring returns when open (e.g., fan interlock).

Three-Position Control with a SPDT Switch or Two Contact Closures (e.g. fan, cooling Y)



Min-Position with Full Open Override (with a single contact closure)



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W606_11

Actuators: NV24-3 US NVD24-3 US NVFD24 (-E) US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

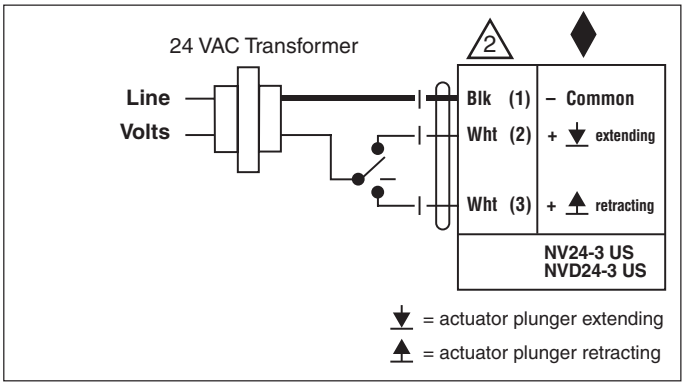
WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

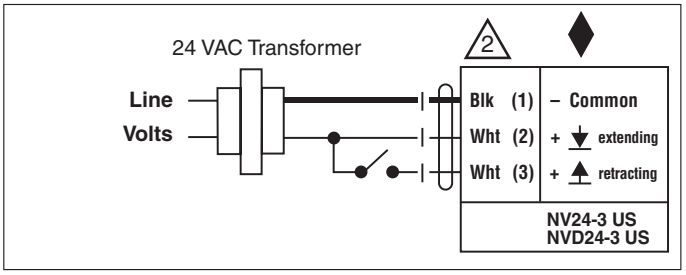
APPLICATION NOTES

Meets cULus requirements without the need of an electrical ground connection.

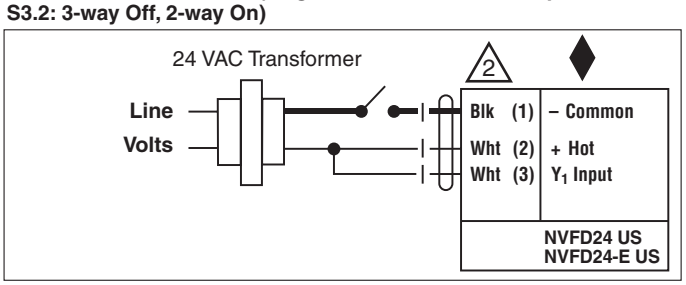
Floating Point and On/Off Control (diagram shown with default position of S1.2: Off)



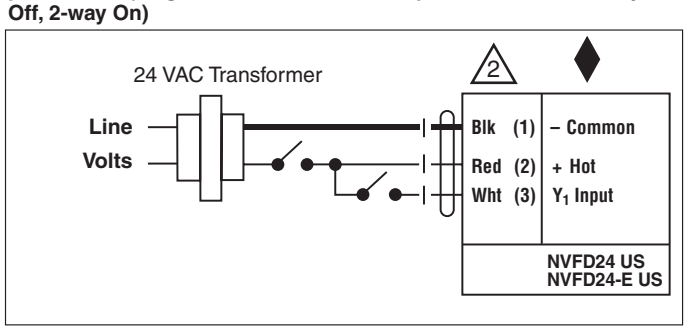
On/Off Control (diagram shown with default position of S1.2: Off)



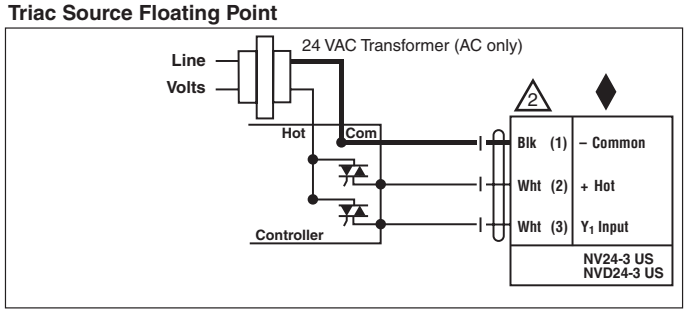
On/Off Control-using actuator to drive one direction and spring the opposite direction. NOTE: A bridge must be made inside the NVF between terminals 2 and 3 **(diagram shown with default position of S3.2: 3-way Off, 2-way On)**



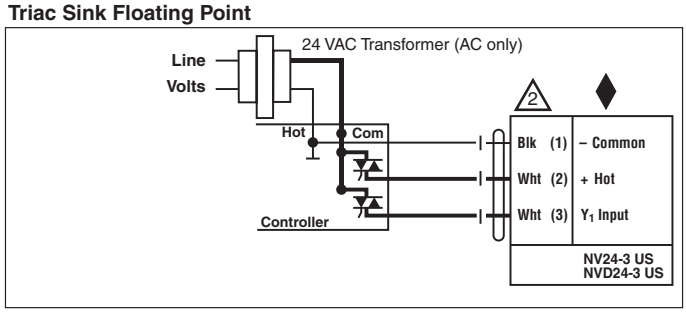
On/Off Control-using actuator to drive open/close, spring upon power loss. (diagram shown with default position of S3.2: 3-way Off, 2-way On)



Triac Source Floating Point



Triac Sink Floating Point



SPRING RETURN ACTUATORS MODEL DESIGNATION

retracting plunger (spring up)
NVFD24 US
NVFD24-MFT US
NVF24-MFT US

extending plunger (spring down)
NVFD24-E US
NVFD24-MFT-E US
NVF24-MFT-E US

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W607_11

Actuators: NVF24-MFT (-E) US NVFD24-MFT (-E) US NV24-MFT US NVD24-MFT US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

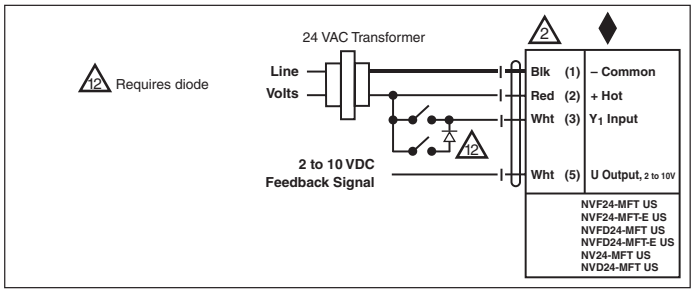
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

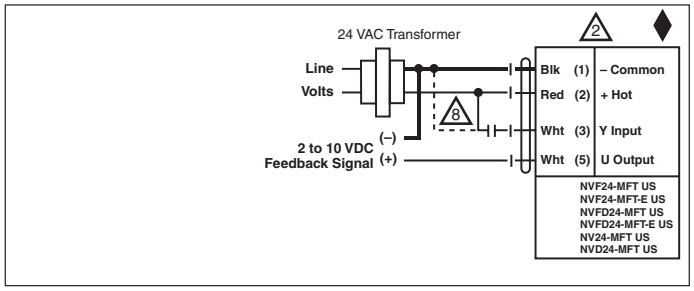
WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

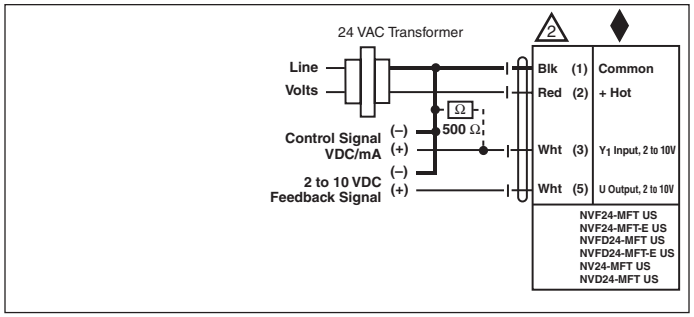
Floating Point Control. (diagram shown with default position of S3.2: 3-way Off, 2-way On.)



Pulse Width Modulation Control Wiring (diagram shown with default position of S3.2: 3-way Off, 2-way On)



MFT Typical 2 to 10 VDC or 4 to 20 mA Wiring (diagram shown with default position of S3.2: 3-way Off, 2-way On)



INSTALLATION NOTES

10 For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller. Position feedback cannot be used with a triac sink controller. The actuator internal common reference is not compatible.

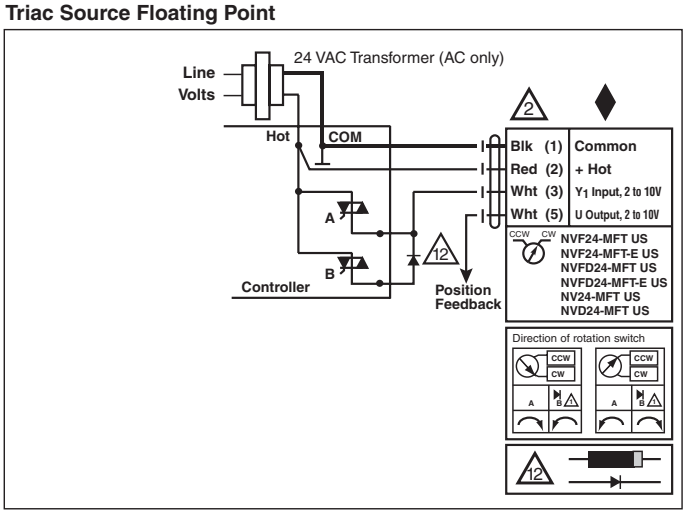
APPLICATION NOTES

Meets cULus requirements without the need of an electrical ground connection.

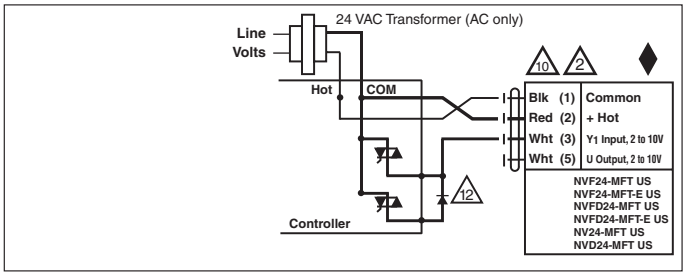
8 Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.

12 IN4004 or IN4007 diode.
(IN4007 supplied, Belimo part number 40155)

Triac Source Floating Point



Triac Sink Floating Point



SPRING RETURN ACTUATORS MODEL DESIGNATION

retracting plunger (spring up)
NVFD24 US
NVFD24-MFT US
NVF24-MFT US

extending plunger (spring down)
NVFD24-E US
NVFD24-MFT-E US
NVF24-MFT-E US

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W228_A_11

Actuators: TF24-MFT US LF24-MFT(-S) US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△4 Equipment damage!
Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC.

△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

△8 Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.

△10 For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller. Position feedback cannot be used with a Triac sink controller. The actuator internal common reference is not compatible.

APPLICATION NOTES

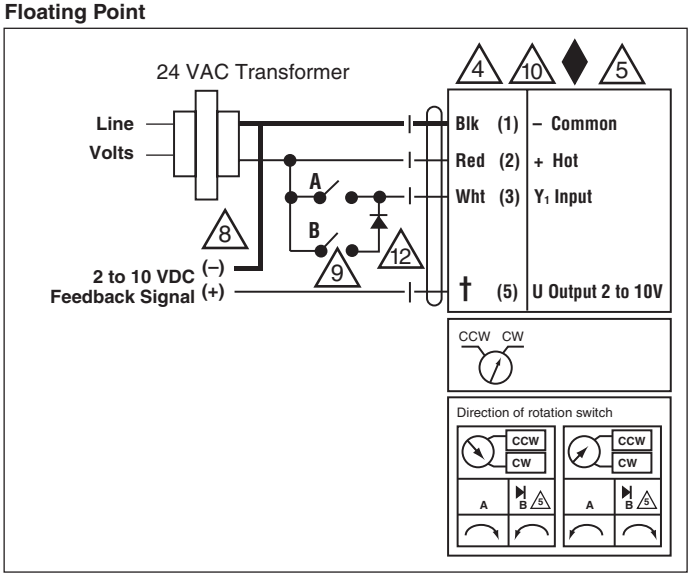
◆ Meets cULus requirements without the need of an electrical ground connection.

△7 A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

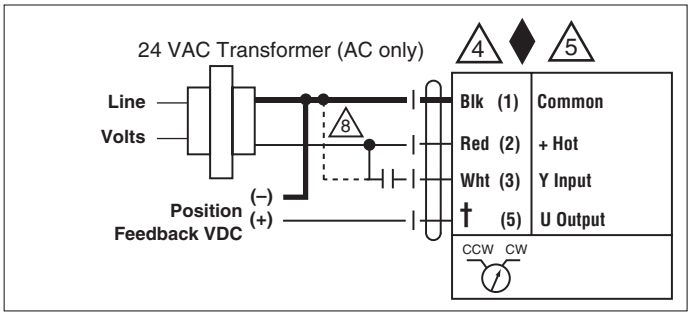
△9 Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.

△12 IN4004 or IN4007 diode. (IN4007 supplied, Belimo part number 40155).

Floating Point



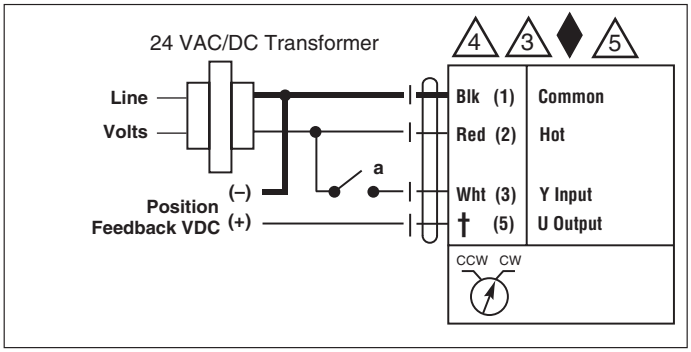
PWM



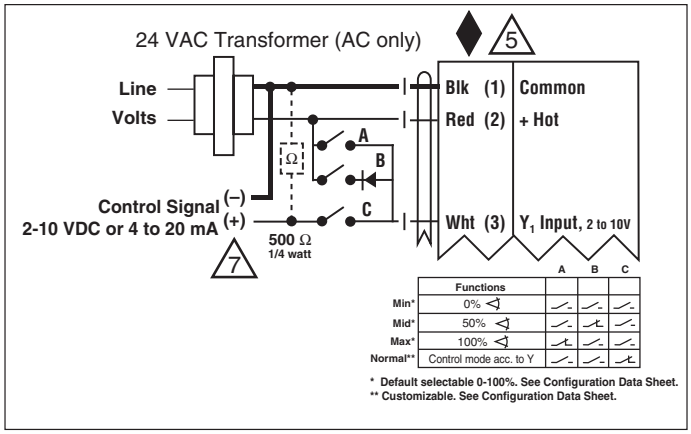
†

Actuator	Wire Number	Color
TF24-MFT US	5	Org
LF24-MFT US	5	Wht

Two Position



Override Control to min, mid, max, Positions



Refer to page 26 for auxiliary switch (-S models) wiring.

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W400_A_11

Actuators: EFB24-MFT(-S) EFX24-MFT(-S) AFB24-MFT(-S) AFX24-MFT(-S) NFB24-MFT(-S) NFX24-MFT(-S) LMX LRX NMX AMX ARX GKX NKQ ARX24-MFT-5 ARB24-MFT-5 GRX24-MFT-5 GMX24-MFT-X1 GRB24-MFT-S GRB24-MFT-5 GRB24-MFT-7

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

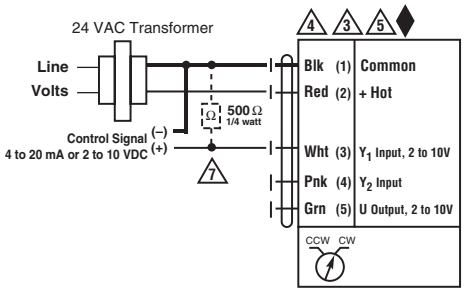
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△4 Equipment damage!
Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

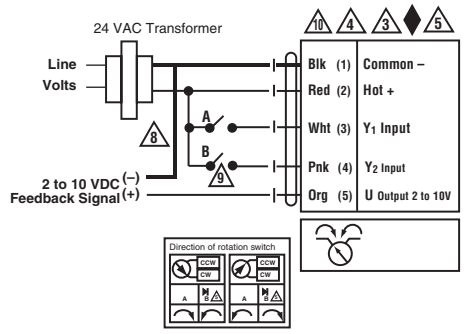
WARNING

Live Electrical Components!
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VDC/4-20 mA

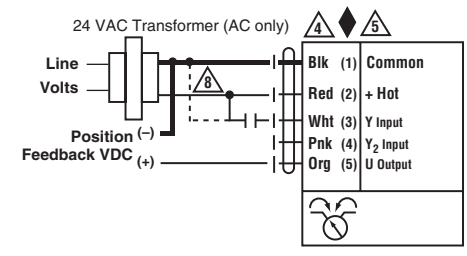


Floating Point (except NKQ)



Triac Source and Sink Diagrams (See page 21)

PWM (except NKQ)



INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC.

△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

△8 Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.

△10 For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller. Position feedback cannot be used with a triac sink controller. The actuator internal common reference is not compatible.

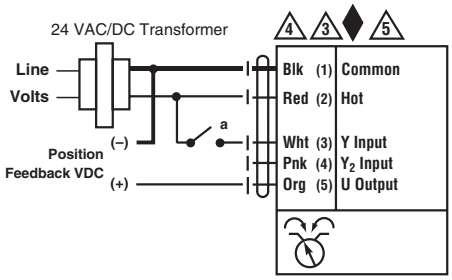
APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

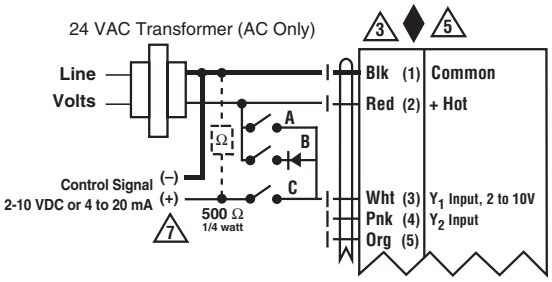
△7 A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

△9 Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.

Two Position



Override Control to min, mid, max, Positions



Functions	a	b	c
Min* 0%	⌐	⌐	⌐
Mid* 50%	⌐	⌙	⌐
Max* 100%	⌙	⌐	⌐
Normal** Control mode acc. to Y	⌐	⌐	⌙

* Default selectable 0-100%. See Configuration Data Sheet.
** Customizable. See Configuration Data Sheet.

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W402_11

Actuators: LMX, LRX, NMX, AMX, ARX, ARX24-MFT-5, ARB24-MFT-5, GMX24-MFT, GMX24-MFT-X1, GRX24-MFT-5, GRX24-MFT-7, GRB24-MFT-5, GRB24-MFT-7

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△4 Equipment damage!
Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

WARNING

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INSTALLATION NOTES

△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

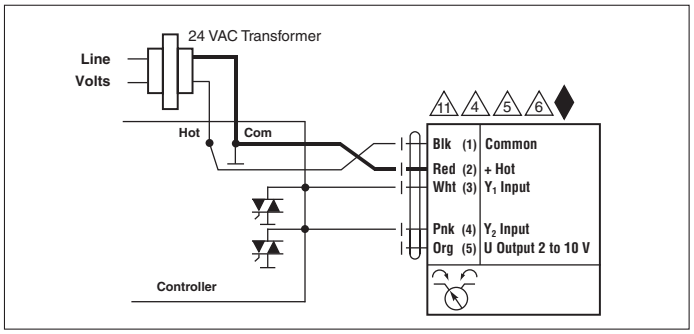
△6 Only connect common neg (-) leg of control circuits.

△11 For triac sink with common connection from the actuator must be connected to the hot connection of the controller. The actuator must be connected to the control board common.

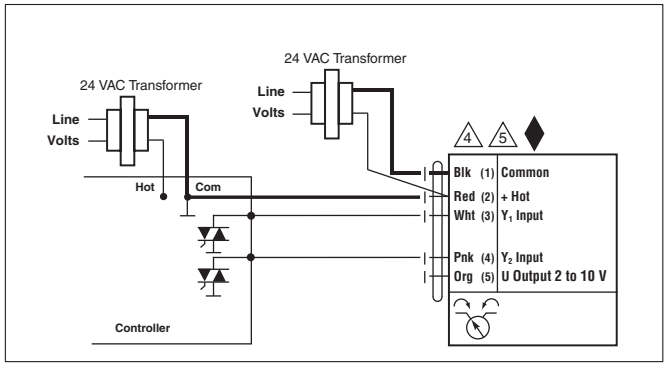
APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

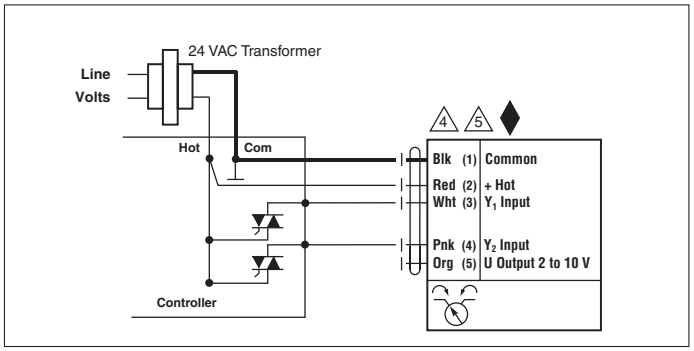
Triac Sink



Triac Sink with Separate Transformer



Triac Source



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W234_A_11

Control Type: PWM

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

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△4 Equipment damage!
Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

Wiring multiple...MFT actuators to single shaft and/or on valves. All MFT actuators are wired in master-slave configuration.

MFT actuator configurations should also co-ordinate with each other. Meaning the master input = controllers output. Master output = slave input. Slave output = controller input.

Example

Controller Output	Master Feedback	Slave Input	Slave Feedback
0.1 to 25.5 sec	2 to 10 VDC	2 to 10 VDC	0 to 5 VDC

Multiple Actuators Mounted to One Control Shaft		
Model	**Max. Qty Per Shaft**	**Torque Generated**
EFB24-MFT(-S) EFX24-MFT(-S)	**3**	**810 in-lb**
AFB24-MFT(-S) AFX24-MFT(-S)	**3**	**432 in-lb**
GMX(B)24-MFT	**2**	**640 in-lb**
GKX(B)24-MFT	**2**	**640 in-lb**

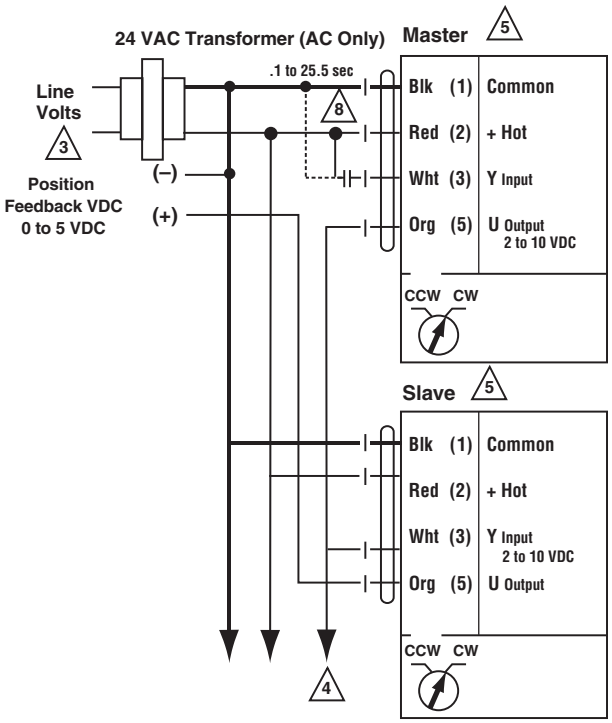
INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC.

△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

△8 Control signal may be pulsed from either the Hot or Common 24 VAC line.

Pulse Width Modulation



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Wnew60408_6

Actuators: AFB24-MFT95 AFX24-MFT95 GMX24-MFT95 AMX24-MFT95 NMX24-MFT95 LMX24-MFT95

INSTALLATION NOTES

5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

21 Provide overload protection and disconnect as required.

22 Actuators and controller must have separate transformers.

23 Consult controller instruction data for more detailed information.

24 Resistor value depends on the type of controller and the number of actuators. No resistor is used for one actuator. Honeywell® resistor kits may also be used.

25 To reverse control rotation, use the reversing switch.

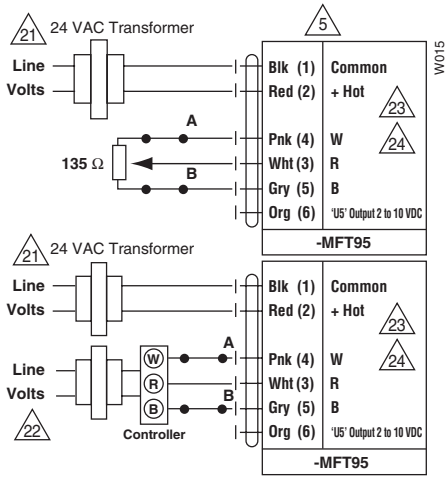
Wire Colors

1 = Black	3 = White	5 = Gray
2 = Red	4 = Pink	6 = Orange

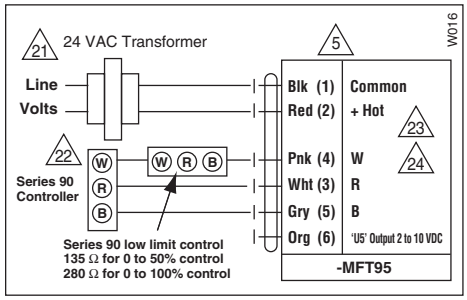
Override

Switch A	Switch B	Damper Position
		Damper Open
		Damper Closed

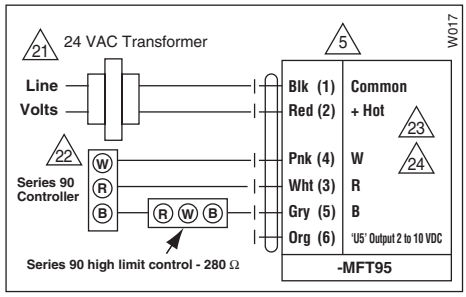
The direction of rotation switch is set so that the fail safe position and the position of the damper is closed with no signal at wire R.



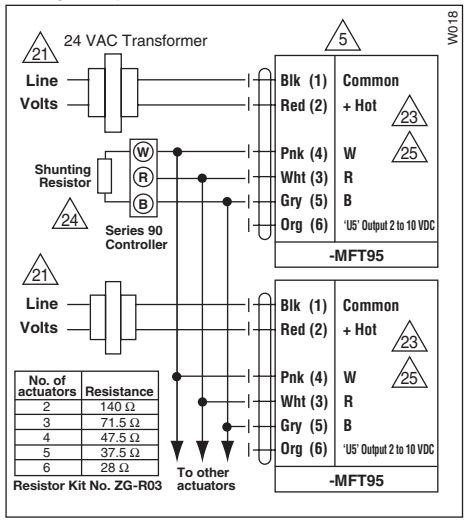
Low Limit Control



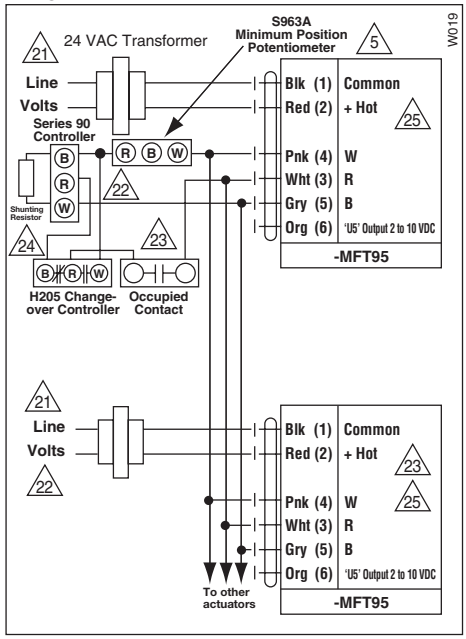
High Limit Control



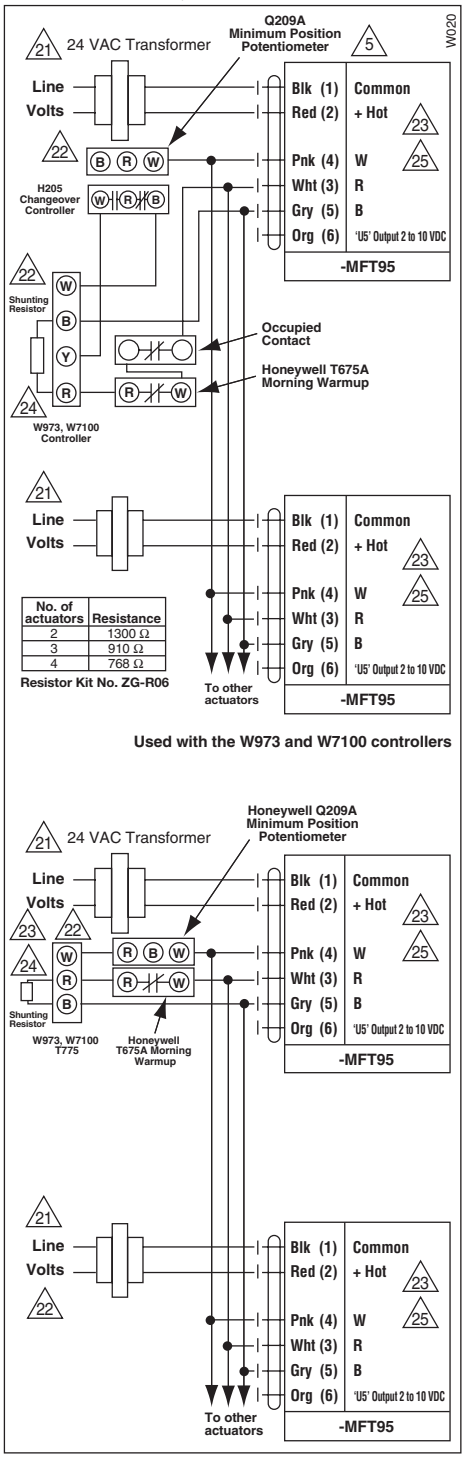
Wiring Multiple Actuators to a Series 90 Controller



Wiring Multiple Actuators to a Series 90 Controller using a Minimum Position Potentiometer



Typical wiring diagrams for multiple actuators used with the W973, W7100 and T775 controllers



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Wiring for Damper Actuators and Control Valves

Proportional, Spring Return, 24V, 6 to 9 VDC
Output Power Supply 20 VDC provides power to controllers

W609_11

Actuators: LF24-MFT-20 US LF24-MFT-S-20 US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

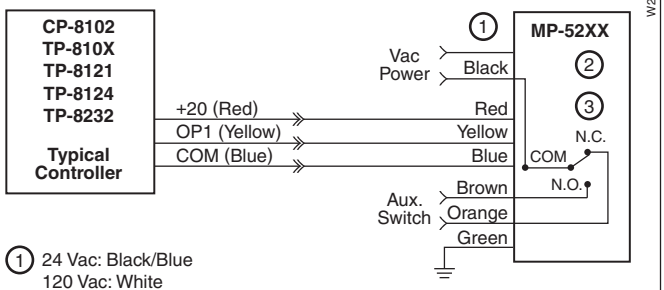
WARNING
Live Electrical Components!
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INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC

△21 Provide overload protection and disconnect as required.

Typical Control Wiring for MP-52XX Series Actuators to Controllers Requiring External 20 VDC Power Supply



① 24 Vac: Black/Blue
120 Vac: White
240 Vac: White/Black
Belimo modulating actuators are 24 VAC/DC, if 120 or 240 is available an external transformer is required.

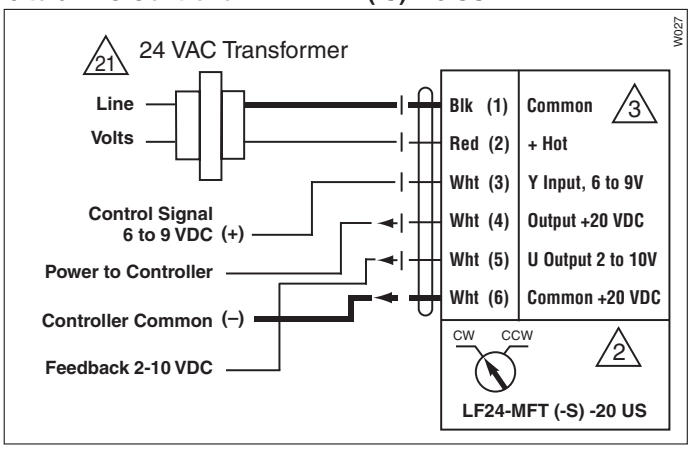
② Maximum of 2

③ MP-52XX-500 models include internal SPDT auxiliary switch.

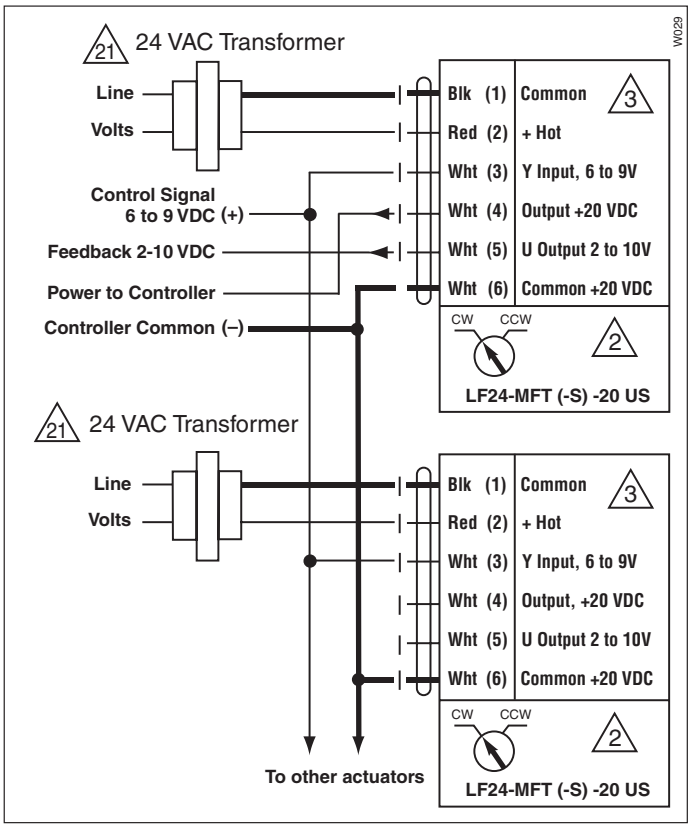
Wire cross reference

MP-52XX	Belimo (SR or MFT)	
Black/Blue, Power	2, Hot	
Black, Power	1, Com	
Red, +20	4, +20 VDC	
Yellow, OP1	3, Signal	
Blue, COM	6, Com VDC	
Brown, N.O.	S3, N.O.	"-S" type
Orange, N.C.	S2, N.C.	"-S" type
Green, Ground	Not used	

6 to 9 VDC Control of LF24-MFT (-S) -20 US



Multiple LF24-MFT (-S) -20 US Actuators from One Controller



Refer to page 26 for auxiliary switch (-S models) wiring.

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W234_2_B_11

Control Type: VDC or 4-20mA MFT95

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

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INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC.

△5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

△21 Provide overload protection and disconnect as required.

△23 Consult controller instruction data for more detailed information.

△25 To reverse control rotation, use the reversing switch.

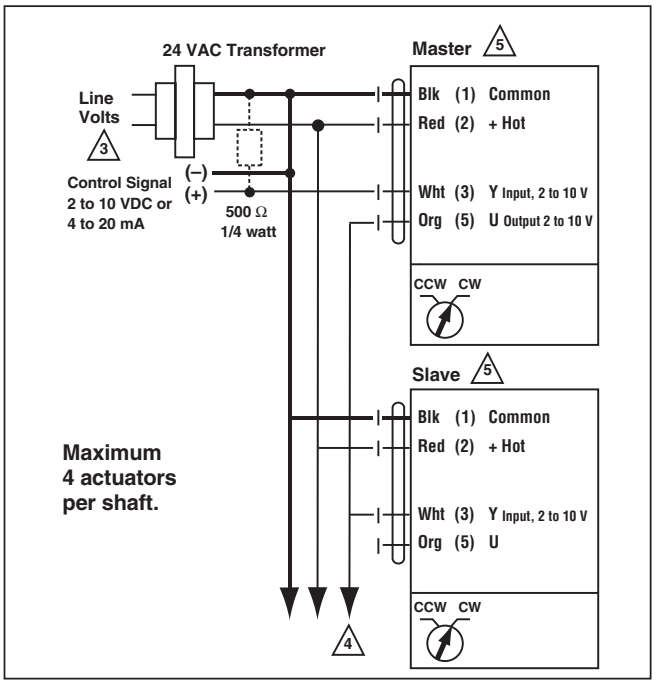
Wiring multiple...MFT actuators to single shaft and/or on valves. All MFT actuators are wired in master-slave configuration.

MFT actuator configurations should also co-ordinate with each other. Meaning the master input = controllers output. Master output = slave input. Slave output = controller input.

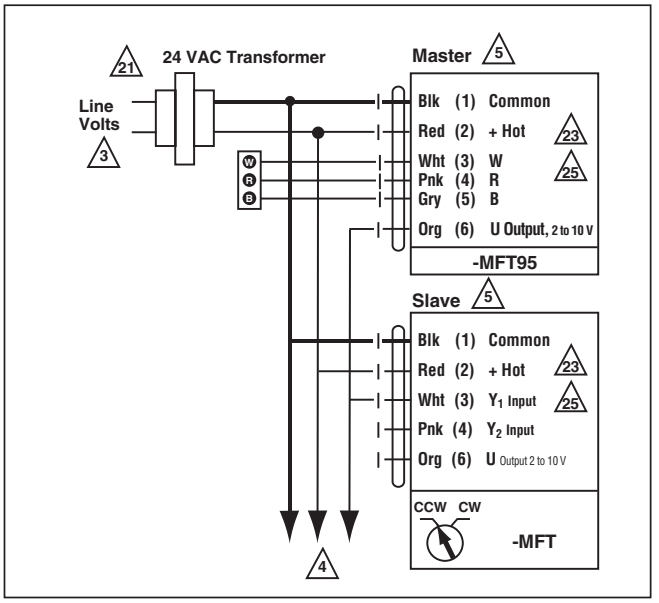
Example

Controller Output	Master Feedback	Slave Input	Slave Feedback
2 to 10 VDC	2 to 10 VDC	2 to 10 VDC	0 to 5 VDC

VDC or 4-20mA



Multiple Actuators Mounted to One Control Shaft



Multiple Actuators Mounted to One Control Shaft		
Model	**Max. Qty Per Shaft**	**Torque Generated**
EFB24-MFT(-S) EFX24-MFT(-S)	**3**	**810 in-lb**
AFB24-MFT(-S) AFX24-MFT(-S)	**3**	**432 in-lb**
GMX(B)24-MFT	**2**	**640 in-lb**
GKX(B)24-MFT	**2**	**640 in-lb**

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W224_A_11

Actuators: EFB...-S EFX...-S AFB...-S AFX...-S AF...-S US NFB...-S NFX...-S LF...-S US TF...-S US AMB(X)...-S LMB(X)...-S ARB(X)...-S LRB(X)...-S S1A/S2A LMB(X)...(-P5)(-P10)

INSTALLATION NOTES

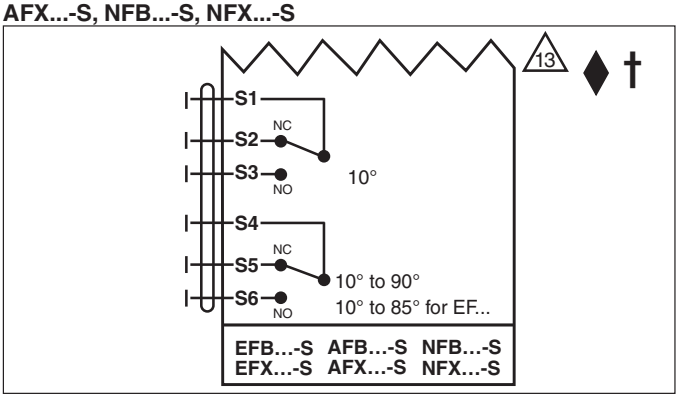
1 One built-in auxiliary switch (1xSPDT), for end position indication, interlock control, fan startup, etc.

13 Two built-in auxiliary switches (2xSPDT), for end position indication, interlock control, fan startup, etc.

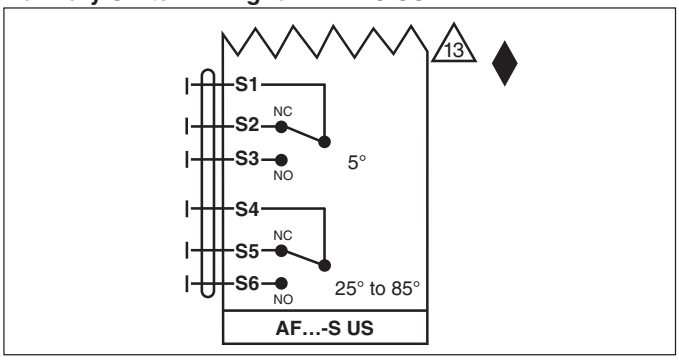
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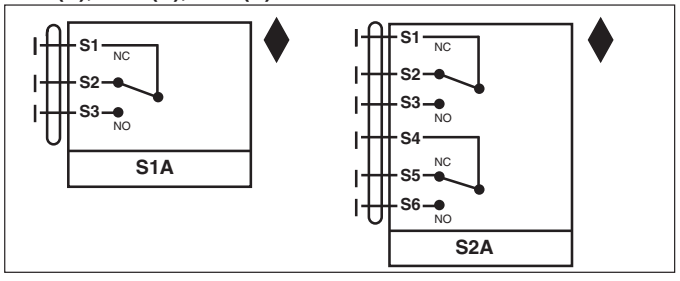
Auxiliary Switch Wiring for EFB...-S, EFX...-S, AFB...-S, AFX...-S, NFB...-S, NFX...-S



Auxiliary Switch Wiring for AF... -S US



Add on Auxiliary Switches S1A/S2A for GMB(X), AMB(X), NMB(X), LMB(X), GRB(X), ARB(X), NRB(X), LRB(X)

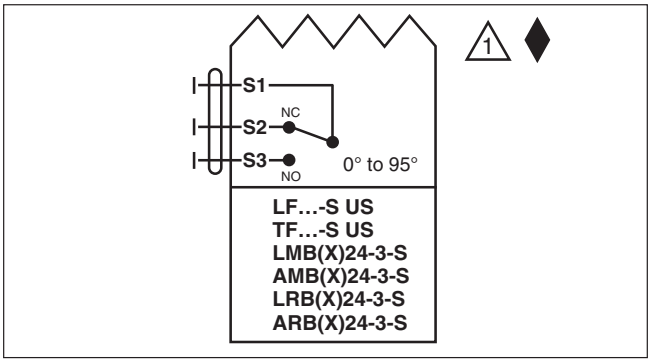


APPLICATION NOTES

Meets cULus requirements without the need of an electrical ground connection.

† Same voltage must be used for dual switch models. Either 24 VAC or line voltage, not both.

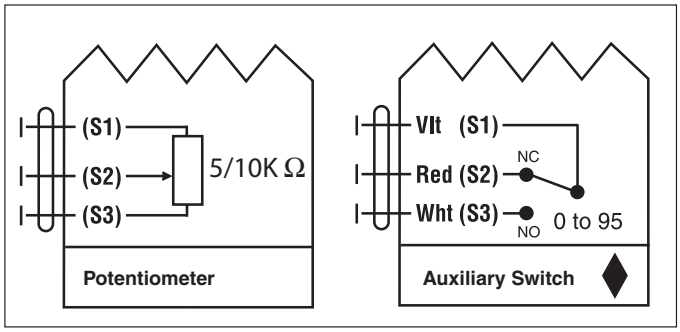
Auxiliary Switch Wiring for LF...-S US, TF...-S, LMB(X)24-3-S, AMB(X)24-3-S, LRB(X)24-3-S, ARB(X)24-3-S



Auxiliary Switch Ratings

Product	Voltage	Resistive Load	Inductive Load
EFB...-S, EFX...-S	250	3.0 A	0.5 A
AFB...-S, AFX...-S	250	3.0 A	0.5 A
AF...-S US	250	7.0 A	2.5 A
NFB...-S, NFX...-S	250	3.0 A	0.5 A
LF...-S US	250	3.0 A	0.5 A
TF...-S US	250	3.0 A	0.5 A
AMB(X)...-S	250	3.0 A	0.5 A
LMB(X)...-S	250	3.0 A	0.5 A
ARB(X)...-S	250	3.0 A	0.5 A
LRB(X)...-S	250	3.0 A	0.5 A
S1A, S2A	250	3.0 A	0.5 A

Potentiometer and Auxiliary Switch Wiring for LMB(X)24-3(-S)(-P5)(-P10)



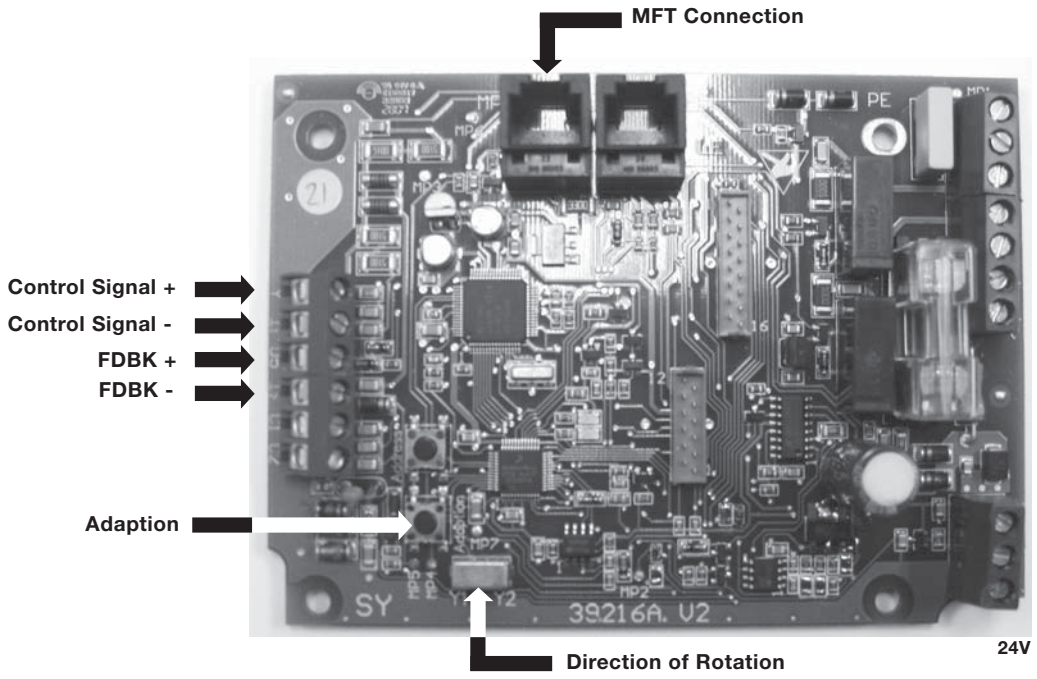
N40067 - 7/11 - Subject to change. © Belimo Aircontrols (USA), Inc.

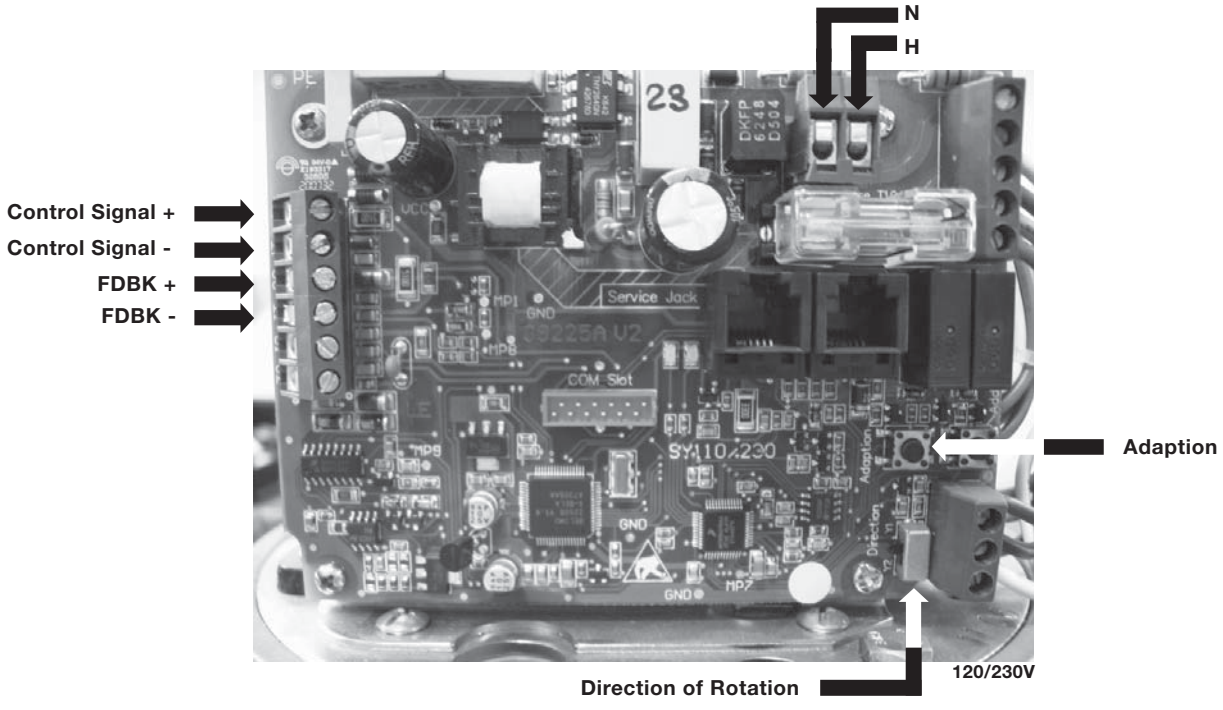
Actuators: SYx-MFT

INSTALLATION NOTES

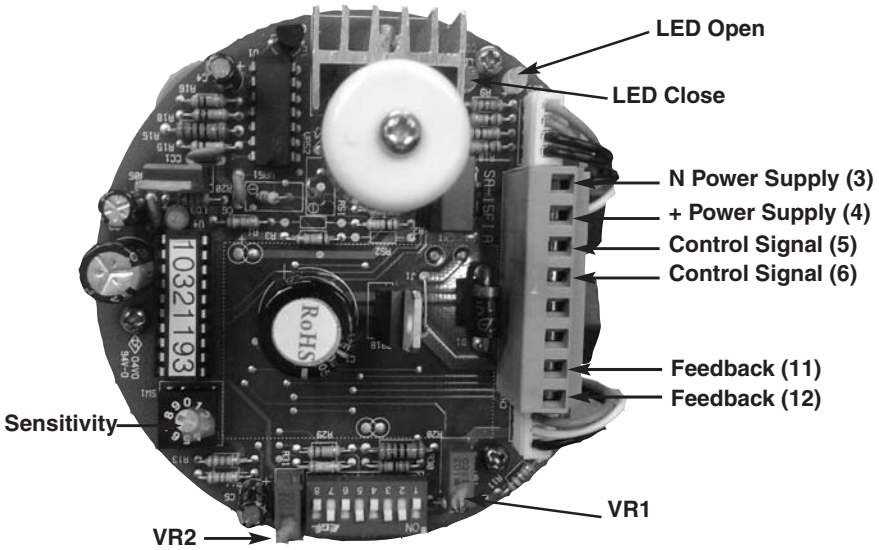
CAUTION

Notes:
1. Motor CAMS have been factory calibrated and should not be moved.
2. An adaption must be performed if any limit switch is adjusted. This will calibrate the beginning and end stopping points. Press the adaption button for 3 seconds and release.





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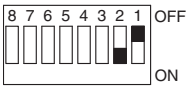
Sensitivity switch setting is position #3 for factory default. To widen dead-band, select a higher number (up to 9).

INSTALLATION NOTES

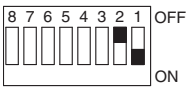
CAUTION

Notes:
1. Do not change sensitivity or dip switch settings with power applied!
2. VR1 and VR2 are factory calibrated and should not be moved.
3. Motor CAMS have been factory calibrated and should not be moved.

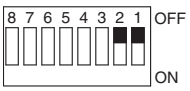
Dip Switch Settings



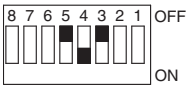
INPUT = 2-10 VDC



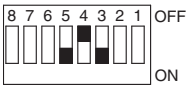
INPUT = 4-20mA



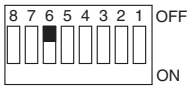
INPUT = 1-5 VDC



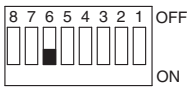
OUTPUT = 4-20mA



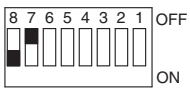
OUTPUT = 2-10 VDC



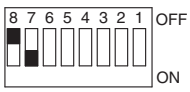
RESPONSE = DIRECT



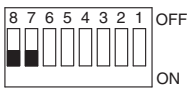
RESPONSE = REVERSE



LOSS OF SIGNAL = CLOSED (Direct Acting)
LOSS OF SIGNAL = OPEN (Reverse Acting)



LOSS OF SIGNAL = OPEN (Direct Acting)
LOSS OF SIGNAL = CLOSED (Reverse Acting)



LOSS OF SIGNAL = STOP

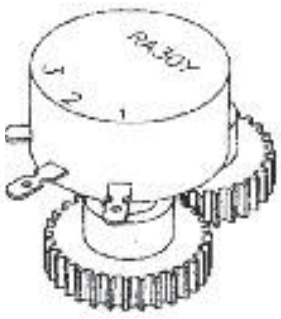
WARNING

Potentiometer (Factory Pre-set)

*On modulating actuators **DO NOT** master/slave using optional potentiometer.

For 2-position actuators with 1k feedback option
Potentiometer points 1, 2, 3 are wired to terminal blocks 8, 9, 10.
When a valve is closed: 8, 9 → 1k Ω
9, 10 → 0k Ω
When a valve is opened: 8, 9 → 0k Ω
9, 10 → 1k Ω

For modulating actuators with 1k feedback option*
Potentiometer points 1, 2, 3 are wired to terminal blocks 8, 9, 10.
When a valve is closed: 8, 9 → 1k Ω
9, 10 → 0k Ω
When a valve is opened: 8, 9 → 0k Ω
9, 10 → 1k Ω



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W546_11

SY Actuator Wiring Diagram, SY1…5-24V – On/Off
SY1…12-120V or 230V On/Off

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

INSTALLATION NOTES

Observe class 1 and class 2 wiring restrictions.

Transformer sizing = SY actuator draw X 1.25 (safety margin)
(Ex. SY2-24 requires 3.0A x 1.25 = 3.75A,
3.75A X 24 VAC = 90VA Transformer).

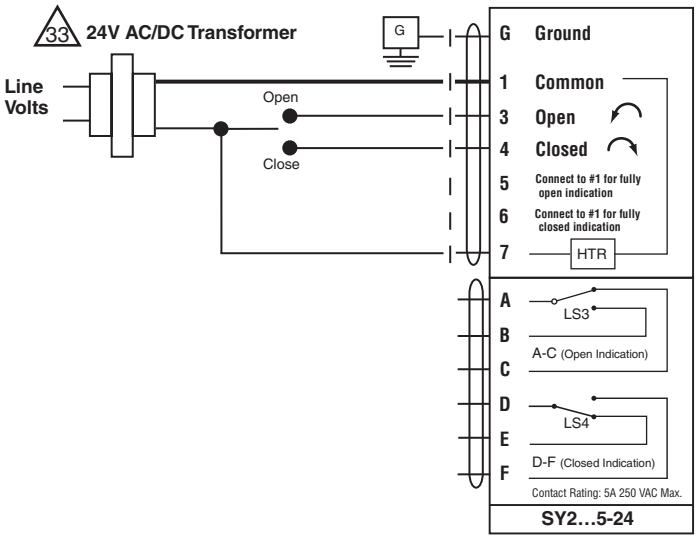
NOTES SY1…5-24

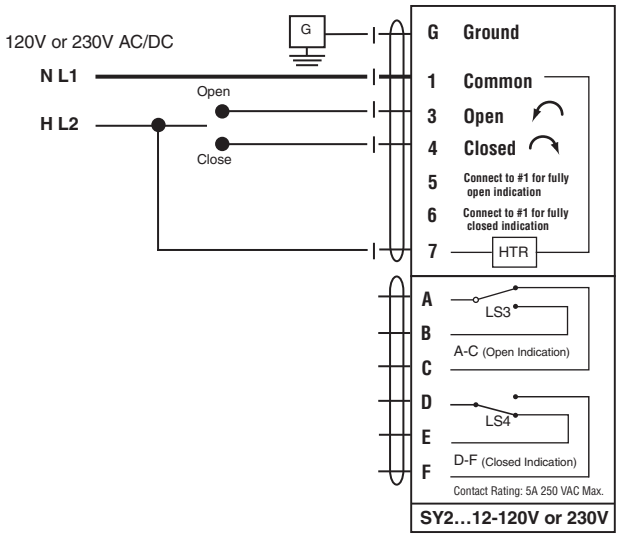
33 Each actuator should be powered by a single, isolated control transformer.

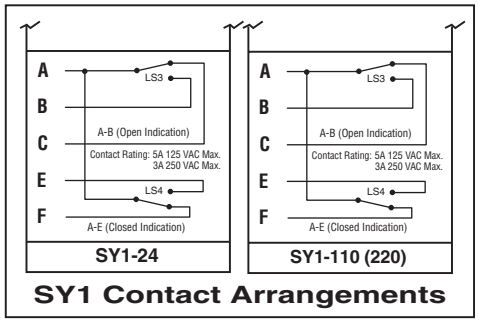
- Isolation relays must be used in parallel connection of multiple actuators using a common control signal input.
- "H" cannot be connected to terminal #3 and #4 simultaneously.
- **Required:** Terminal #7 needs to be field wired to enable heater circuit.

NOTES SY1…12-120V or 230V

- **Caution:** Power Supply Voltage
- Isolation relays must be used in parallel connection of multiple actuators using a common control signal input.
- "H" (L2) cannot be connected to terminal #3 and #4 simultaneously.
- **Required:** Terminal #7 needs to be field wired to enable heater circuit.







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W547_11

SY Actuator Wiring Diagram, SY1-24P and SY1-110P (220P)

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

INSTALLATION NOTES

Observe Class 1 and Class 2 wiring restrictions.

Transformer sizing = SY actuator draw X 1.25 (safety margin)
(Ex. SY2-24 requires 3.0A x 1.25 = 3.75A, 3.75A X 24 VAC = 90VA Transformer)

APPLICATION NOTES

34 Ground shielded wire at control panel chassis. Tape back ground at actuator.

36 Use of feedback is optional.

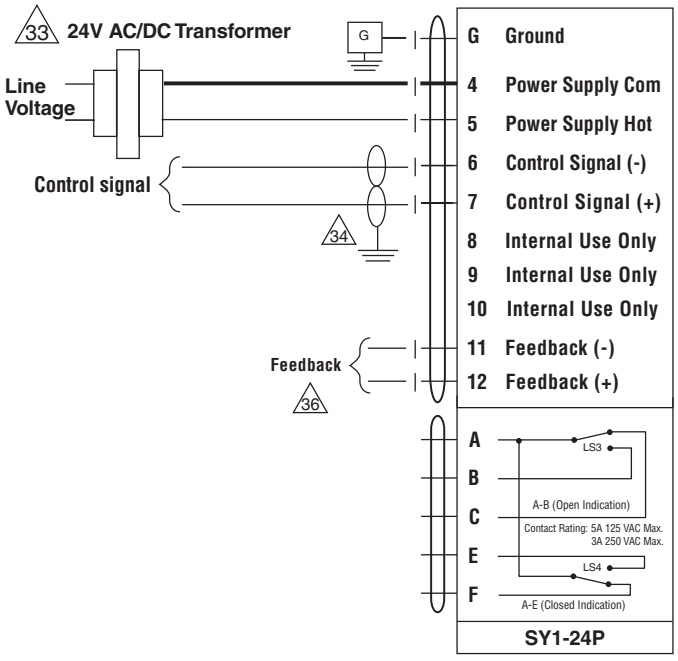
NOTES SY1...24P

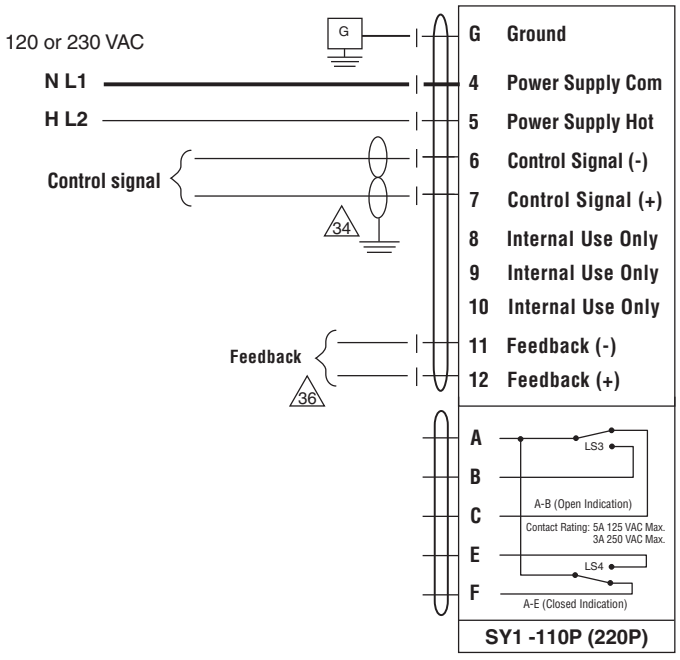
33 Each actuator should be powered by a single, isolated control transformer.

- Power supply Com/Neutral and Control Signal "–" wiring to a common is prohibited. Terminals 4 and 6 need to be wired separately.
- Do not change sensitivity or dip switch settings with power applied.

NOTES SY1...110P (220P)

- **Caution:** Power supply voltage.
- Power supply Com/Neutral and Control Signal "–" wiring to a common is prohibited. Terminals 4 and 6 need to be wired separately.
- Do not change sensitivity or dip switch settings with power applied.





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W547_2_11

Actuator: SY2…5-24MFT SY2...12-120MFT SY2...12-230MFT

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

INSTALLATION NOTES

Observe Class 1 and Class 2 wiring restrictions.

Transformer sizing = SY actuator draw X 1.25 (safety margin)
(Ex. SY2-24 requires 3.0A x 1.25 = 3.75A, 3.75A X 24 VAC = 90VA Transformer)

APPLICATION NOTES

34 Ground shielded wire at control panel chassis. Tape back ground at actuator.

36 Use of feedback is optional.

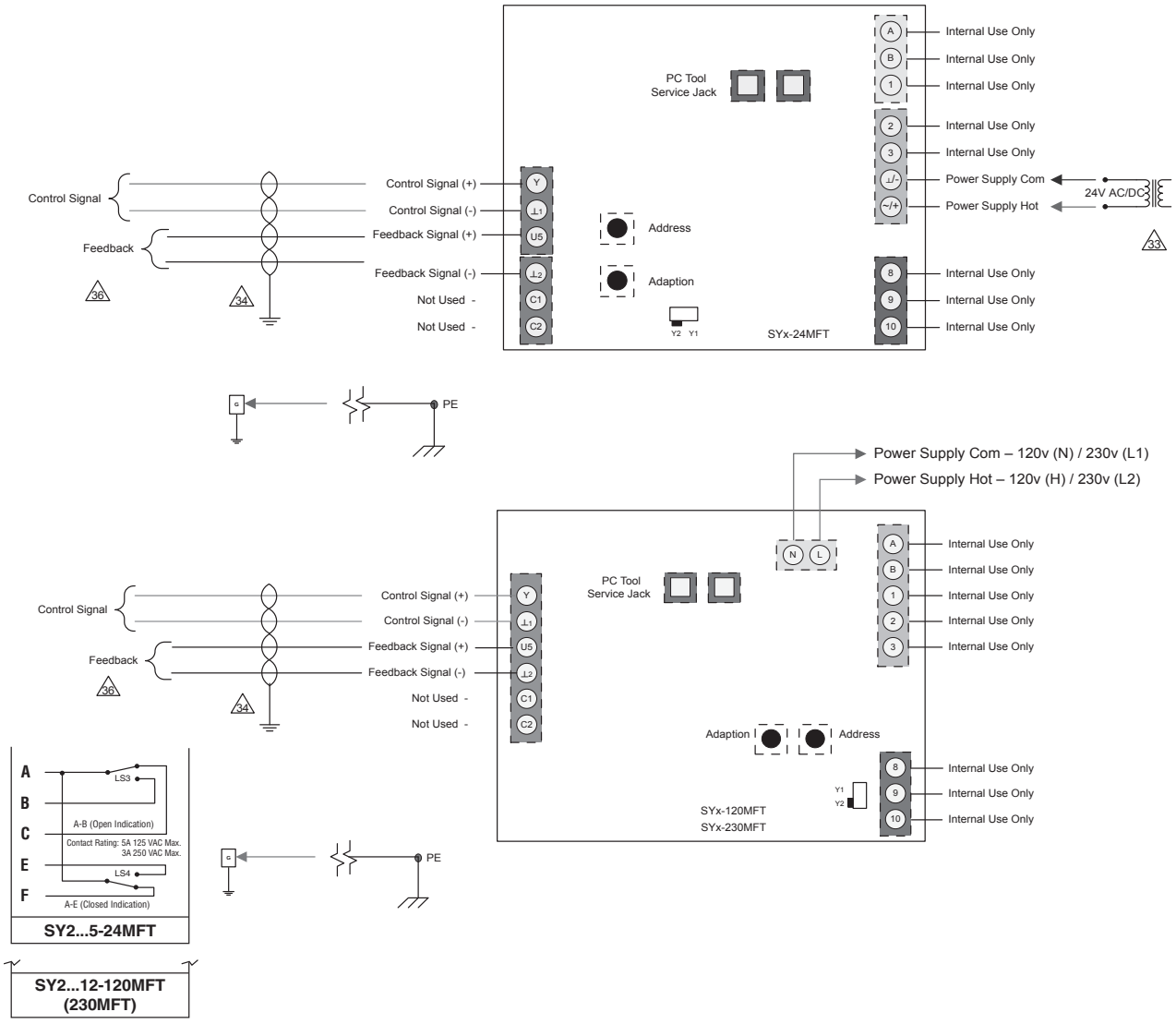
NOTES SY2...5-24MFT

33 Each actuator should be powered by a single, isolated control transformer.

- Power supply Com/Neutral and Control Signal "–" wiring to a common is prohibited.

NOTES SY2...12-120MFT (230MFT)

- **Caution:** Power supply voltage.



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W549_11

SY Actuator Wiring Diagram, SY1…5-24 – Multiple Wiring
SY1…12-110 (220) – Multiple Wiring

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

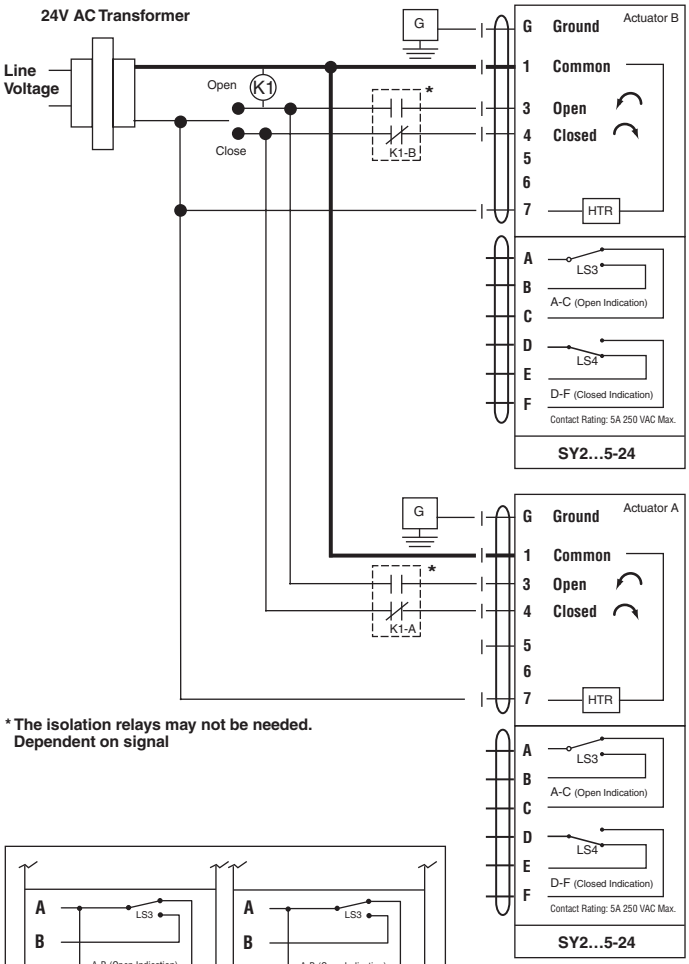
INSTALLATION NOTES

Observe class 1 and class 2 wiring restrictions.

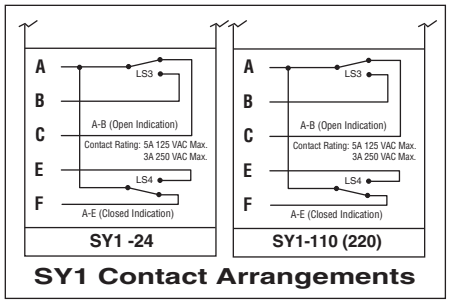
Transformer sizing = SY actuator draw X 1.25 (safety margin)
(Ex. SY2-24 requires 3.0A x 1.25 = 3.75A,
3.75A X 24 VAC = 90VA Transformer).

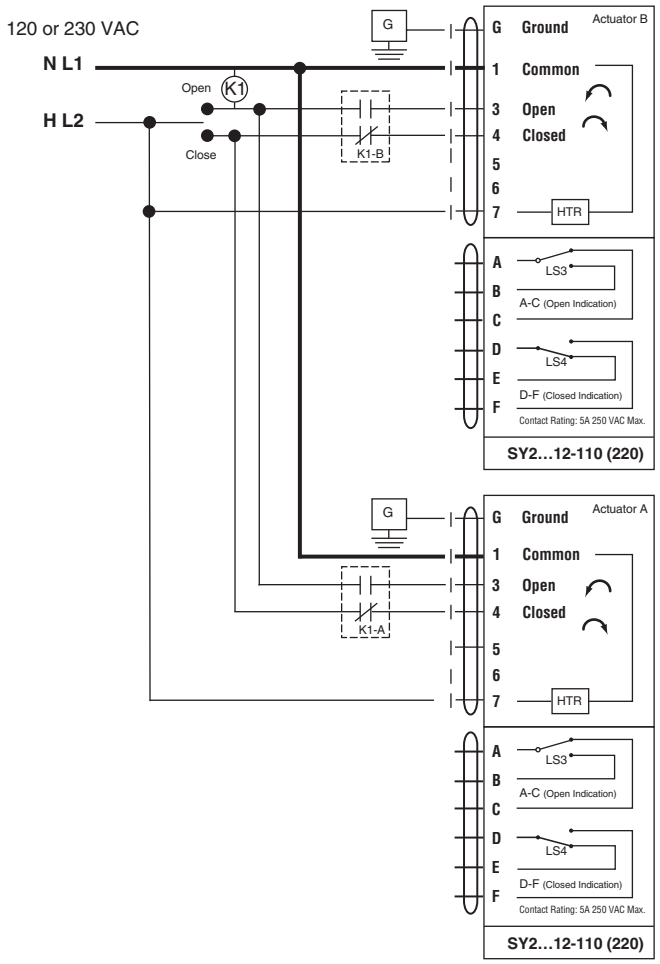
NOTES

- **Caution:** Power Supply Voltage.
- Isolation relays must be used in parallel connection of multiple actuators using a common control signal input.
- "H" (L2) cannot be connected to terminal #3 and #4 simultaneously.
- **Required:** Terminal #7 needs to be field wired to enable heater circuit.



*The isolation relays may not be needed. Dependent on signal





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W550_11

SY Actuator Wiring Diagram, SY1-24P – Multiple Wiring

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

INSTALLATION NOTES

Observe class 1 and class 2 wiring restrictions.

Transformer sizing = SY actuator draw X 1.25 (safety margin)
(Ex. SY2-24 requires 3.0A x 1.25 = 3.75A,
3.75A X 24 VAC = 90VA Transformer).

NOTES SY1-24P

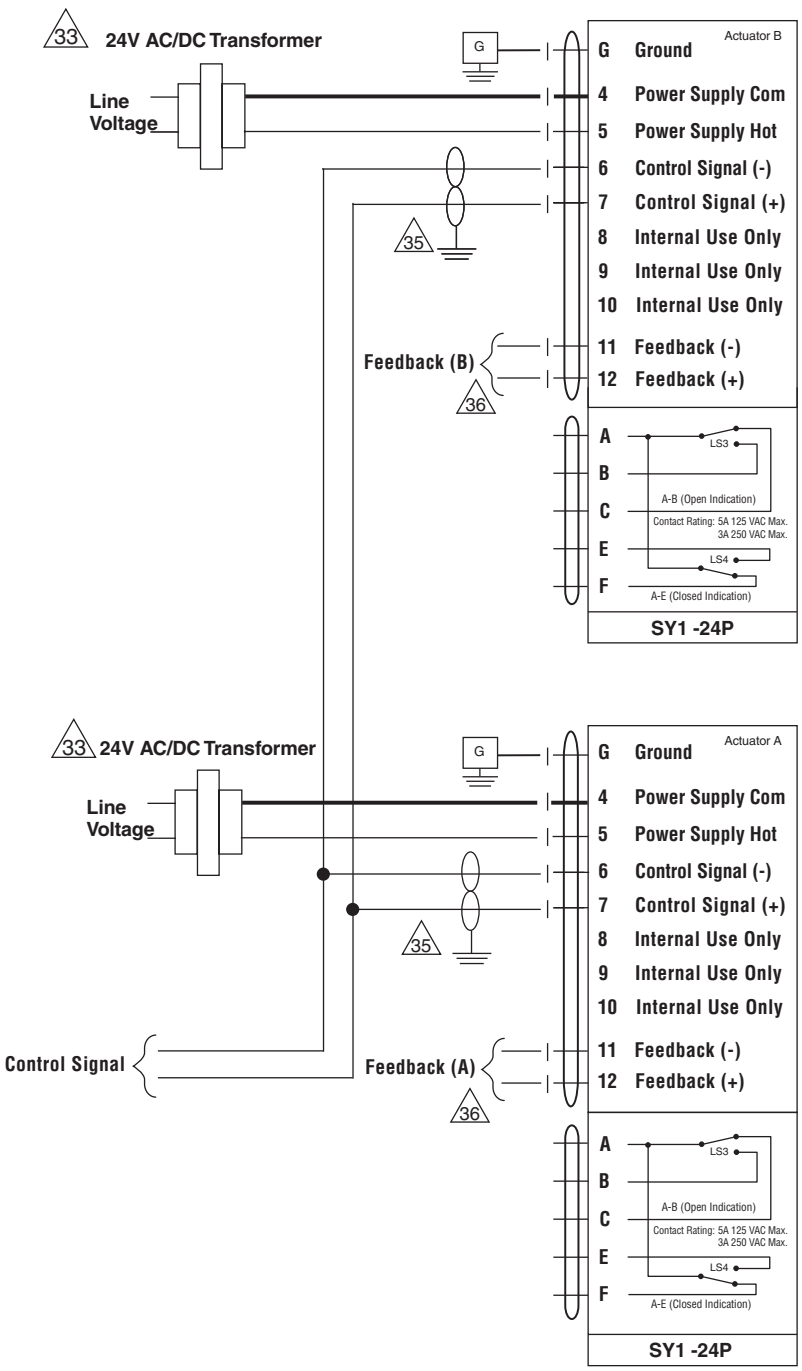
33 Each actuator should be powered by a single, isolated control transformer.

- **SY1-24P notes:** Power supply Com/Neutral and Control Signal "–" wiring to a common is prohibited. Terminals 4 and 6 need to be wired separately otherwise irreversible damage will occur.
- Do not change sensitivity or dip switch settings with power applied.

APPLICATION NOTES

35 Recommended twisted shielded pair for control wiring. Ground shielded wire at control panel chassis. Tape back ground at actuator.

36 Use of feedback is optional.



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W550_2_11

Actuators: SY2...5-24MFT

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

INSTALLATION NOTES

Observe class 1 and class 2 wiring restrictions.

Transformer sizing = SY actuator draw X 1.25 (safety margin)
(Ex. SY2-24 requires 3.0A x 1.25 = 3.75A,
3.75A X 24 VAC = 90VA Transformer).

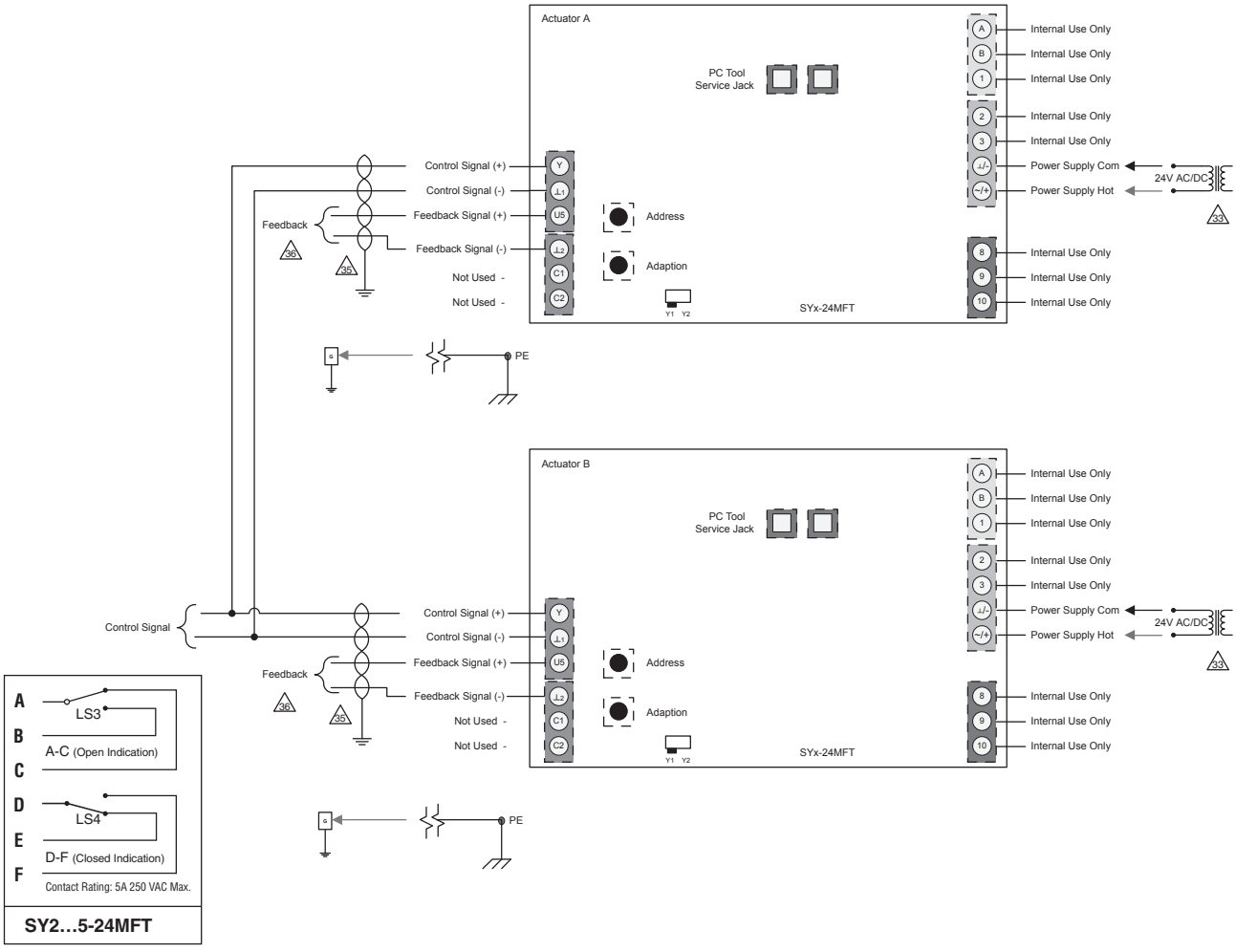
NOTES SY2...5-24MFT

33 Each actuator should be powered by a single, isolated control transformer.

APPLICATION NOTES

35 Recommended twisted shielded pair for control wiring.
Ground shielded wire at control panel chassis.
Tape back ground at actuator.

36 Use of feedback is optional.



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W552_1_11

Actuators: SY1-110P SY1-220P

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

INSTALLATION NOTES

Observe class 1 and class 2 wiring restrictions.

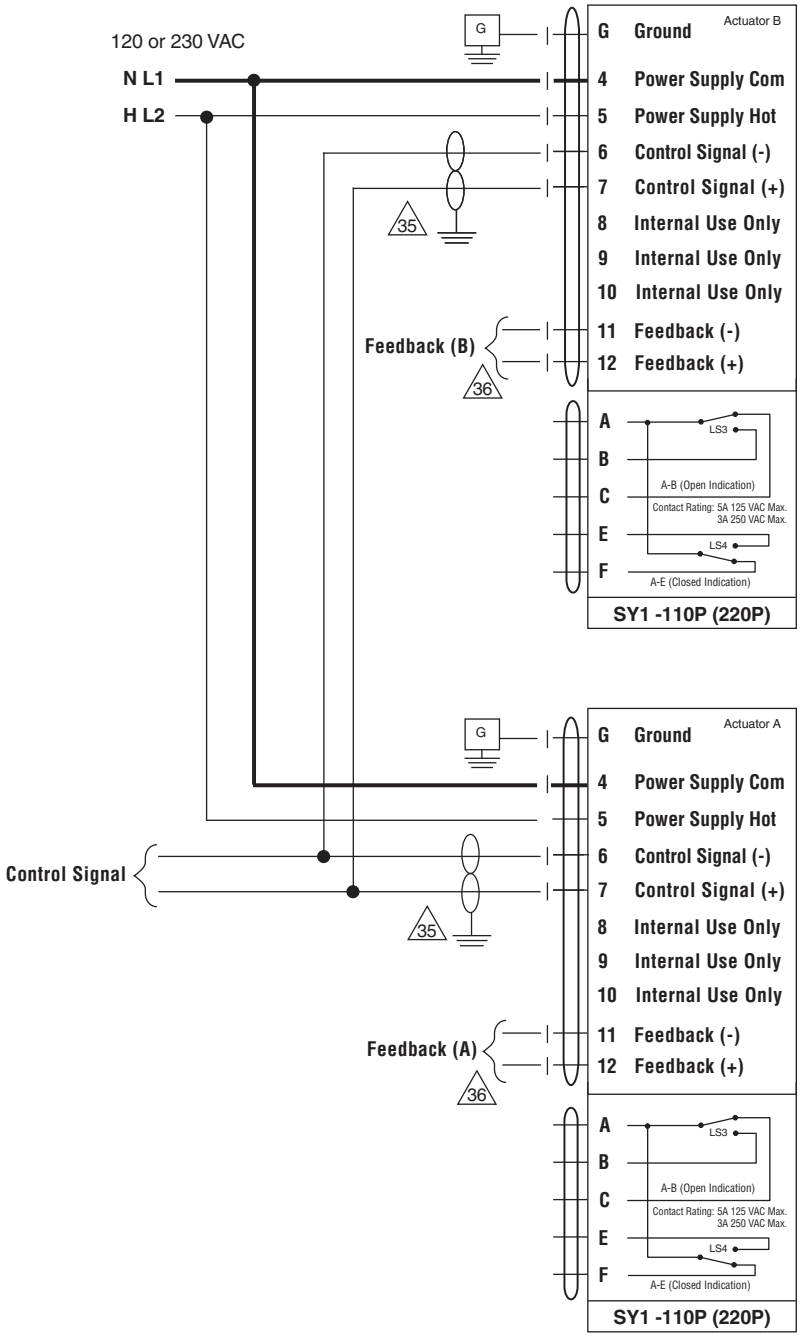
APPLICATION NOTES

△35 Recommended twisted shielded pair for control wiring. Ground shielded wire at control panel chassis. Tape back ground at actuator.

△36 Use of feedback is optional.

NOTES SY1-110P (220P)

- **Caution:** Power supply voltage.
- Do not change sensitivity or dip switch settings with power applied.



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W552_2

Actuators: SY2...12-120MFT SY2...12-230MFT

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

INSTALLATION NOTES

Observe class 1 and class 2 wiring restrictions.

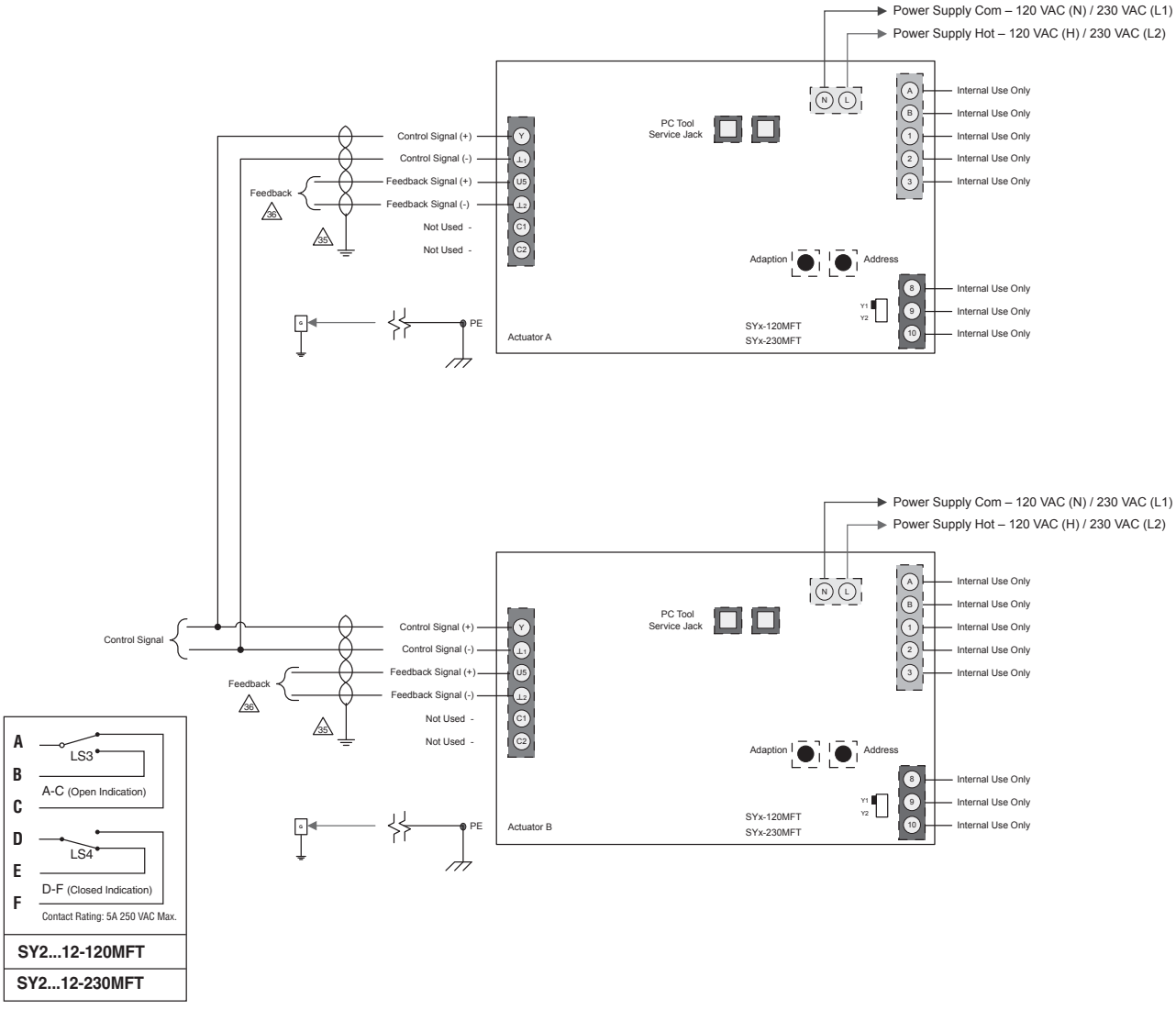
APPLICATION NOTES

35 Recommended twisted shielded pair for control wiring.
Ground shielded wire at control panel chassis.
Tape back ground at actuator.

36 Use of feedback is optional.

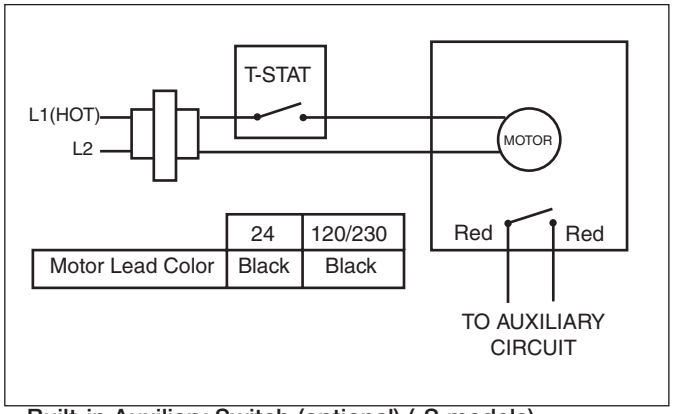
NOTES SY2...12-120MFT (230MFT)

- **Caution:** Power supply voltage.



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Actuators: ZONE 24NC ZONE24NO ZONE24NC-S ZONE24NO-S ZONE120NC ZONE120NO ZONE120NC-S ZONE120NO-S



Built-in Auxiliary Switch (optional) (-S models)

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W610_11

Actuators: FSLF120(-S) US FSLF24(-S) US FSNF120(-S) US FSNF24(-S) US FSAF120(-S) US FSAF24(-S) US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

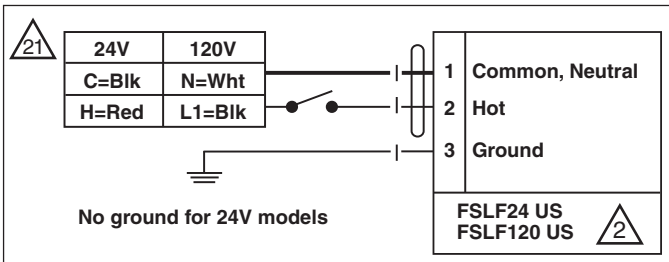
△2 Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

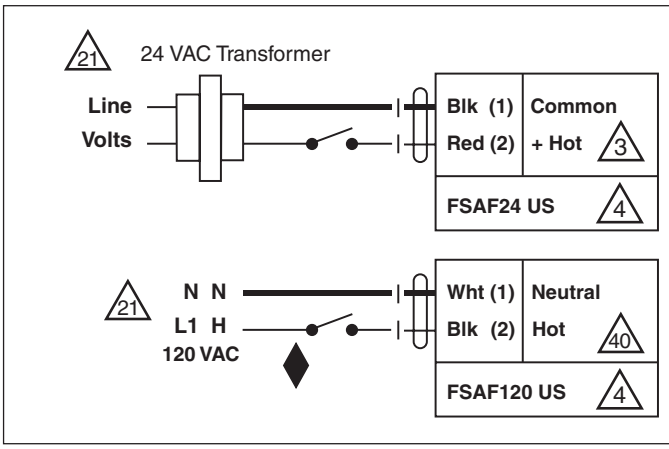
△4 Equipment damage!
Actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

All ●—● on this page indicates ●—┌┐● manual reset high temperature limit or relay.





INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC.

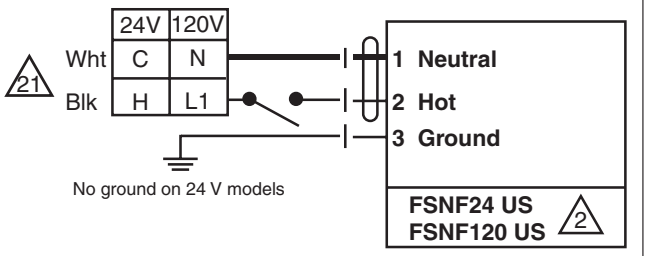
△13 Two built-in auxiliary switches (2xSPDT), for end position indication, interlock control, fan startup, etc.

△21 Provide overload protection and disconnect as required.

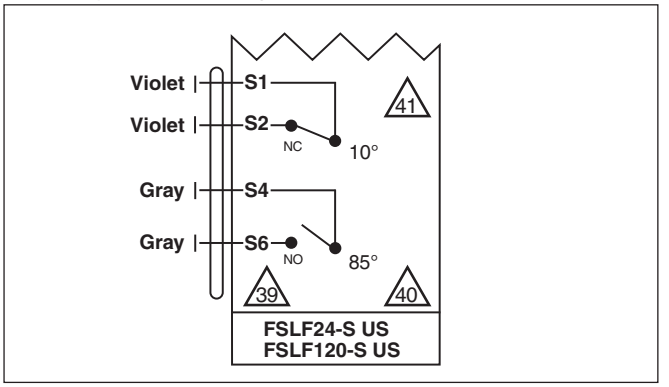
△39 S4 makes to S6 when the actuator is powered open.

△40 Double insulated.

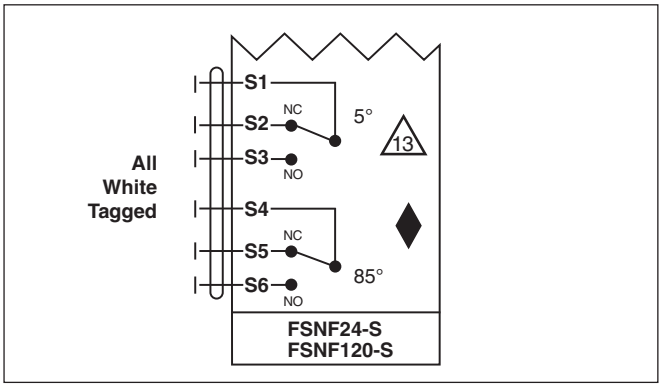
△41 Two built-in auxiliary switches (2xSPST), for end position indication, interlock control, fan startup, etc.



Auxiliary Switch Wiring for FSLF24-S US, FSLF120-S US



Auxiliary Switch Wiring for FSNF24-S US, FSNF120-S US



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W611_11

Actuators: FSAF24-BAL (-S) US FSAF24-SR US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

△2 Equipment damage!
Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

△4 Equipment damage!
Actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

APPLICATION NOTES

♦ Meets cULus or UL requirements without the need of an electrical ground connection.

INSTALLATION NOTES

△3 Actuators may also be powered by 24 VDC.

△6 Only connect common neg (-) leg of control circuits.

△7 A 500 Ω resister converts the 4 to 20 mA control signal to 2 to 10 VDC.

△13 Two built-in auxiliary switches (2xSPDT), for end position indication, interlock control, fan startup, etc.

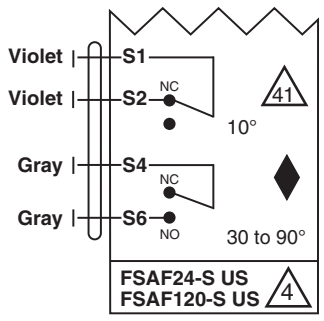
△21 Provide overload protection and disconnect as required.

△37 Only connect Hot, Wire 2 to Wire 3 override controls.

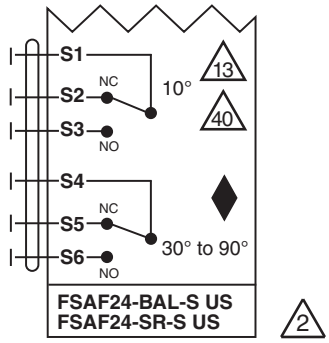
△40 Double Insulated

All ●—● on this page indicates ●—┐● manual reset high temperature limit or relay.

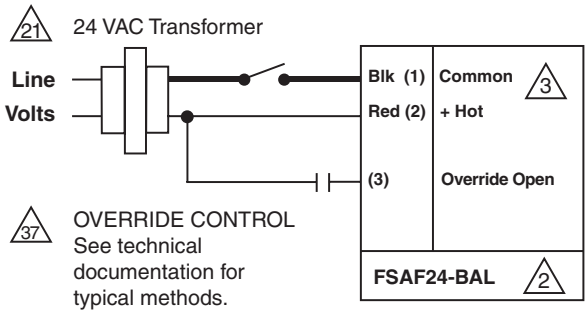
Auxiliary Switch Wiring for FSAF24-S US, FSAF120-S US



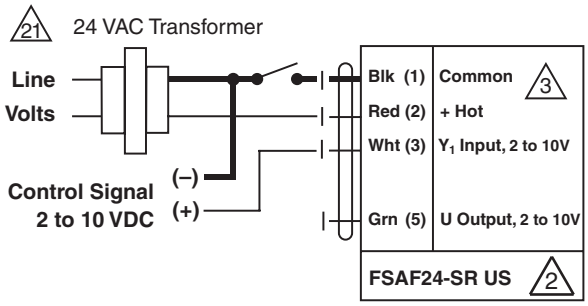
Auxiliary Switch Wiring for FSAF24-BAL-S US, FSAF24-SR-S US

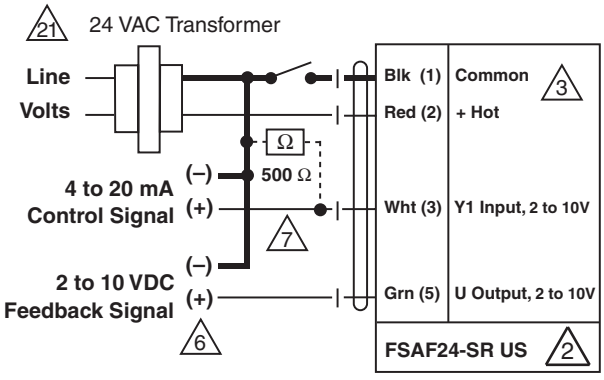


Balancing Control Fire and Smoke



Proportional Control Fire and Smoke





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Notes

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Savage, MD 20763-0414
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With branches in MD, VA

Amcon Controls, Inc.
11906 Warfield Street
San Antonio,TX 78216
Phone: 210-349-6161
Houston, TX branch 713-464-7002
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Applied Automation
A Wilson Mohr Company
3186 South Washington Street, #230
Salt Lake City, UT 84115
Phone: 801-486-6454

Boston Aircontrols, Inc.
8 Blanchard Road
Burlington, MA 01803
Phone: 781-272-5800

Charles D. Jones Co.
445 Bryant Street, Unit #1
Denver, CO 80204-4800
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With branches in CO, MO, KS

Climatic Control Div/ICD
5061 W. State Street
Milwaukee, WI 53208
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Cochrane Supply and Engineering, Inc.
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Madison Heights, MI 48071-1633
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With branches in MI and Maumee, OH

Columbus Temperature Control
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Columbus, OH 43201
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Controlco
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Oakland, CA 94607
Phone: 510-636-7900
With branches in CA, NV

Control Products
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Houston, TX 77447
Phone: 713-849-7200

Edward C. Smyers & Co.
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Pittsburgh, PA 15222-1505
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Engineered Control Systems
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St. Louis, MO 63144
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South Side Control Supply, Co.
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Chicago, IL 60610-3923
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Twinco Supply Corporation
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Huntington Station, NY 11746-2143
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With branches in NY

Wilson-Mohr, Inc.
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Sugarland, TX 77478
Phone: 281-295-8850

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